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ABSTRACT

THIS STUDY PROPOSED (1) TO VERIFY THAT STUDENTS OF NORMAL ABILITY COULD LEARN STRUCTURAL AND TRANSFORMATIONAL GRAMMAR CONCEPTS PRESENTED IN THE FORMAT OF LINEAR PROGRAMING, AND (2) TO TEST WHETHER THE STUDENTS WOULD APPLY THE CONCEPTS IN COMPOSITIONS SO THAT THEIR WRITING SHOWED PROGRESS TOWARD MATURITY. PARTICIPATING IN THE EXPERIMENT WERE 207 EIGHTH-GRADE STUDENTS IN TWO SCHOOLS. ONE HUNDRED STUDENTS STUDIED ONE PROGRAMED LESSON PER DAY FOR 22 DAYS; THE REST OF THE STUDENTS SERVED AS THE CONTROL GROUP. COMPARISON OF SCORES ON OBJECTIVE PRE- AND POST-TESTS SHOWED EXPERIMENTAL STUDENTS DEMONSTRATING A SIGNIFICANT GRASP OF THE CONCEPTS AND AN INCREASE IN SENTENCE-COMBINING SKILLS. OTHER RESULTS SHOWED FEMALES SCORING HIGHER THAN MALES, ABLE STUDENTS LEARNING MORE THAN THE LESS ABLE, AND STUDENTS LEARNING MORE IN ONE SCHOOL (UPPER-MIDDLE ECONOMIC LEVEL) THAN IN THE LOWER-MIDDLE SCHOOL. FOR THE SECOND PART OF THE STUDY, 1000-WORD WRITING SAMPLES WERE OBTAINED FROM ALL STUDENTS BEFORE AND AFTER THE EXPERIMENT, AND THE PAPERS OF 114 STUDENTS WERE RANDOMLY SELECTED FOR EXAMINATION. RESULTS SHOWED THAT EXPERIMENTAL STUDENTS INCREASED THEIR USE OF SUBORDINATION AND, FURTHERMORE, THAT STUDENTS IN THE UPPER-MIDDLE SCHOOL ADVANCED MORE THAN THE OTHER SCHOOL'S STUDENTS IN THEIR USE OF SUBORDINATION. (THIRTY-THREE STATISTICAL TABLES ARE INCLUDED.) (AUTHOR/LH)

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Technical Report No. 69

THE EFFECT OF A STUDY OF GRAMMAR ON THE WRITING OF EIGHTH-GRADE STUDENTS

By Nathan S. Blount, Wayne C. Fredrick, and Shelby L. Johnson

Report from the Individually Guided Instruction in
English Language, Composition, and Literature Project
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Wisconsin Research and Development
Center for Cognitive Learning
The University of Wisconsin
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STATEMENT OF FOCUS

The Wisconsin Research and Development Center for Cognitive Learning focuses on contributing to a better understanding of cognitive learning by children and youth and to the improvement of related educational practices. The strategy for research and development is comprehensive. It includes basic research to generate new knowledge about the conditions and processes of learning and about the processes of instruction, and the subsequent development of research-based instructional materials, many of which are designed for use by teachers and others for use by students. These materials are tested and refined in school settings. Throughout these operations behavioral scientists, curriculum experts, academic scholars, and school people interact, insuring that the results of Center activities are based soundly on knowledge of subject matter and cognitive learning and that they are applied to the improvement of educational practice.

This Technical Report is from the Individually Guided Instruction in English Language, Composition, and Literature Project in Program 2. General objectives of the Program are to establish rationale and strategy for developing instructional systems, to identify sequences of concepts and cognitive skills, to develop assessment procedures for those concepts and skills, to identify or develop instructional materials associated with the concepts and cognitive skills, and to generate new knowledge about instructional procedures. Contributing to these Program objectives, the long-range objective of the English Project is to install and test materials for individually guided instruction in language, composition, and literature. Prerequisite activities include formulating behavioral objectives for students and teachers, based on a content and concepts outline, and developing measurement instruments related to the behavioral objectives.

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ABSTRACT

207 eighth-grade students in two schools participated in a test of programed materials in structural and transformational grammar. The materials were 22 lessons that were studied by 100 of the Ss at the rate of one lesson per day. Some experimental Ss received exercises in applying the content of the lessons. The performances of the 100 experimental Ss and 107 control Ss were compared on pretests and posttests. These comparisons showed significant learning of concepts by the experimental Ss and an increase in their sentence-combining skills. Other test results showed females scoring higher than males, able students learning more than the less able, and more learning in School A than in School B. The regression between pretest and posttest scores was high and significant but the regression between IQ and posttest score was not significant. The exercises were not a significant factor on the tests.

1000-word writing samples were obtained from all Ss prior to and after the experiment. Statistical comparisons were based on the tabulations of 114 randomly selected Ss. These comparisons showed that while control and experimental Ss were equal on prewriting, the treatment increased the use of subordination by the experimental Ss on the postwriting. Further analyses showed that Ss in School A had advanced in their use of subordination more than Ss in School B. No sex differences were present in the writing measures and only minimal differences due to intellectual ability were seen. Prewriting measures such as clause length, T-unit length, sentence length, clauses per T-unit, and T-units per sentence were significant covariates on postwriting while IQ and frequency data on types of clauses were not.

The Ss spent about 20 minutes on each lesson and the error rate in responding to the programed frames was low. The Ss judged the difficulty of the content appropriate and thought that the lessons were interesting and helpful. They rated the clues for recognizing sentence structures especially useful.

I
INTRODUCTION

STATEMENT OF THE PROBLEM

The purpose of the present study was two-fold. The first task was to verify that students of normal ability in a usual classroom setting could and would learn concepts of structural and transformational grammars when these concepts were presented in the format of linear programing. The second task was to test whether students who have learned concepts of structural and transformational grammars apply these concepts in compositions so that their writing would show detectable progress toward maturity.

RELATED RESEARCH

The question of whether the study of grammar improves writing ability has received much attention (c.f. reviews of research by Braddock, Lloyd-Jones, and Schoer, 1963; and Meckel, 1963). The question as posed, however, involves two related issues. One must ask, Which grammar does one teach? and secondly, To what end is it taught, that is, what is meant by improved writing? Prior to the recent availability of "new" grammars, traditional grammar was taught for its editorial function in reducing errors. However, research showed that other methods were usually superior to the usage prescriptions of the traditional grammar. Among these superior methods were a thought approach (Frogner, 1939), incidental teaching as errors appeared (Milligan, 1939; Kraus, 1959) and a direct method (Harris, 1962). The implication in some of the studies was that the error oriented approach depressed the spontaneous production of complex sentences (Milligan, 1939; Harris, 1962).

Other experimenters tried to answer the general question of the effect of grammar study by using other grammars. Johnson (1960), however, found that a structural approach was no different from a traditional approach in reducing errors or improving the overall quality of written themes. Blake (1964) showed that structural grammar was relatively ineffective in teaching punctuation. Schuster (1961) and Suggs (1961) found structural grammar at least as effective as traditional grammar when the criteria were verbal abilities measured by objective tests. But O'Donnell (1963) pointed out that neither approach correlated very highly with excellence in written composition.

The ineffectiveness of these grammars seems largely due to a narrow and incorrect view of the objectives. What was needed was a more relevant specification of the kinds of changes in writing that were desired. If the only objective was reduction of errors, this could be achieved by a simple reduction in the amount of writing, a step which some children apparently take under pressure to write perfectly. The combination of the new grammars, including structural and transformational approaches, and the specification of indexes which measure maturity in writing has led to the goal that instruction in grammar can operate constructively to develop writing behavior which becomes progressively more like that of mature adults.

Studies based on structural grammar as a means of measuring progressive changes toward maturity showed that the use of certain sentence patterns (NP + V, NP + V + NP, NP + be + adj, and NP + be + NP) increased with increasing age (Sam and Stine, 1965); that the variety of sentence patterns increased with age (Strickland, 1962; Riling, 1965); that children of low intelligence never used some of the structures available to other children (Riling, 1965; Loban, 1963); that the number of words per "sentence" increased with increasing age (Riling, 1965; Loban, 1963); and that the use of subordinate clauses increased with both age and intelligence (Loban, 1963). Studies based on transformational grammar revealed that the use of certain transforms increased with age, while nongrammatical transformations decreased (Menyuk,

1963, 1964), and that there appeared to be ages at which transform rules were first overgeneralized before eventually being applied properly (Menyuk, 1964).

A significant mapping of the developmental use of grammatical structures was undertaken by Hunt (1965), who attempted to find the most objective, systematic measure of writing characteristics at various grade levels. Hunt was dissatisfied with sentence length because young children tend to use many "ands" and not enough periods, tendencies which result in long "sentences" that are not equal to the long sentences of mature writers. Hunt developed other measures which he rightly felt were much superior to sentence length, namely T-unit length, number of short T-units, and clauses per T-unit. (T-units were defined by Hunt as the shortest word groups grammatically capable of being terminated with a capital letter and a period.) T-unit length, for example, increased from 8.6 words at Grade 4 to 11.5 words at Grade 8 and 14.4 words in Grade 12. Adult writers averaged 20.3 words per T-unit. Hunt showed that the increase in T-unit length resulted from two factors, an increase in subordinate clause length, which develops early, and an increase in the number of subordinate clauses, which comes later. The increase in frequency came especially in the use of adjective clauses (They double in frequency from Grade 4 to Grade 12.), although the use of movable adverb clauses and certain noun clauses also increased. The increase in clause length was from such factors as use of adjectives, genitives, prepositional phrases, infinitives, participles to modify nouns, auxiliary verbs, near-clause nominals, and coordination within T-units.

The measures developed by Hunt have been tested on other groups of eighth and twelfth graders (Blount, Johnson, and Fredrick, in press) and have been extended to samples of children in Grades K, 1, 2, 3, 5, and 7 for both oral and written discourse (O'Donnell, Griffin, and Norris, 1967). These studies each verified that T-unit length was a revealing and objective measure of writing maturity. The latter study demonstrated that the number of sentence-combining transformations increased significantly with grade level in both speech and writing and was closely approximated by the more easily computed T-unit length.

The work of Hunt, which was based on transformational grammar, was instrumental in providing the present authors with suitable criteria for detecting changes in writing behavior resulting from knowledge of structural and transformational grammar. Other studies have shown that these grammars could be taught under laboratory-school conditions.

Bateman and Zidonis (1966) reported that knowledge of generative-transformational grammar increased the proportion of well formed sentences, decreased the number of malformed sentences and errors in applying transformation rules, and resulted in increased structural complexity of sentences with no loss in grammaticality. These conclusions were based upon the writing samples of 41 ninth and tenth graders in a university-affiliated experimental high school. Though the sample was small and probably atypical, the data on error reduction and proportion of well formed sentences seemed impressive. For example, after the two-year treatment the experimental Ss reduced their error rate by 81% compared to a 47% reduction for the control group, which studied no grammar. The experimental group produced structurally correct sentences 88% of the time compared to 63% for the control group. However, other data obtainable from the report were negative. The experimental group, which prior to the experiment produced a writing sample of 20,209 words, dropped to 17,183 words following the study of generative grammar. The control group during the same time went from 15,129 words to 18,302 words. Since the writing samples were obtained under the same conditions, the decline in quantity of writing was a noteworthy effect attributable to the experimental treatment. Although the sentences of experimental Ss were transformationally complex (in the case of one obviously precocious experimental S, 70 transformational operations were detected in an average sentence, while prior to the treatment his average complexity level was six such operations), the frequency of transformations increased only one for the experimental Ss (from 5.39 to 6.30 transformations per sentence) and more than two for the control Ss (from 4.80 to 7.47). Thus, it appears that well formed, errorless, complex transformations were obtained at the cost of a reduction in quantity of writing and a decrease in the use of transformations within a sentence. As in the studies of Milligan (1939) and Harris (1962), the emphasis upon correctness seems to have suppressed spontaneous writing.

Blount, Klausmeier, Johnson, Fredrick, and Ramsay (1967) showed that eighth-grade students would, if paid, learn a significant amount of structural and transformational grammar from a series of lessons prepared in a programed format. The study suggested that writing exercises, which allowed Ss to apply the grammars in the production of novel sentences, would facilitate performance in productive situations such as classroom composition. The 1967 study led directly to the present experiment which tests the effect of the programed

lessons, with and without writing exercises, in producing mature writing where maturity is defined on the basis of Hunt's work with T-units.

Two studies, which appeared after the data for the present research had been collected, suggested that teaching the concepts of structural and transformational grammar is feasible and will transfer to writing behavior. Mellon (1967) showed that a series of lessons and sentence-combining exercises increased markedly the number of nominal and relative clauses and phrases occurring in the written compositions of seventh-grade students. The exercises, which allowed the pseudoproduction of fully formed, complex sentences from sets of kernel-like statements, were apparently successful in causing students to elaborate and diversify the structures within T-units, though the gain in length of T-units was relatively moderate. The second study, (Gale, 1968) reported no significant differences between a traditional and structural-transformational approach on measures of T-unit length and number of malformed sentences. However, the experimental group increased significantly the complexity of its well formed sentences. Gale further reported that the fifth graders of her study understood the concepts relatively easily.

II
PROCEDURES

Students and teachers in eight eighth-grade English classes participated in this study during the first semester of the school year 1966-1967. There were two experimental groups and one control group. Four kinds of data were collected from the experimental Ss: 2000-word writing samples from each student, scores on objective tests, tabulations of errors and time on the 22 program lessons, and the responses to a questionnaire of opinions toward the treatments. The control group wrote the 2000-word writing samples and took the objective tests.

SUBJECTS, TEACHERS, AND SCHOOLS

The Ss were 242 students in the eighth grade from two junior high schools of a Midwestern city which had a population of about 35,000. Four intact English classes from each school, two classes in the morning and two in the afternoon, provided a cross section of students representative of the entire schools. Since the two schools were located in areas of the city corresponding to different economic levels, (i.e., School A was upper-middle, School B lower-middle) school was considered a factor in some statistical analyses. The two teachers participating in this study, Teacher A in School A and Teacher B in School B, each conducted two experimental classes and two control classes.

The experimental classes received programed instruction in structural and transformational grammar. One-half of each experimental class received Treatment W, which was programed lessons plus writing exercises, and one-half received Treatment WO, which was the same programed lessons but without writing exercises. The control groups (C) did not study grammar during the experiment.

The Ss' IQ scores on the Kuhlmann-Anderson Intelligence Test, Seventh Edition, Booklet EF (KAT), were supplied by the schools. For some statistical analyses the Ss were divided into three ability levels—high, medium, and low. This was done by ranking the students on the basis of their KAT scores and then assigning the top one-third to the high ability group, the middle one-third to the medium ability group, and the bottom one-third to the low ability group. The ranges of IQ for low, medium, and high were: 90-106, 107-118, and 119-145. The mean IQ for all students was 113.

The data from 35 students were discarded for the following reasons: 22 had no KAT score on record or had taken an intelligence test other than the KAT; 11 had KAT scores below 90, exceeding the lower limit of the range set by the investigators; and 2 had incomplete experimental test data. Of the remaining 207 Ss, 100 were in the experimental groups and 107 were in the control groups. The mean IQ scores of the various groups and the numbers of Ss in each group are shown in Table 1.

TREATMENT

The experimental treatment (W and WO) consisted of 22 programed lessons in English syntax and morphology. A summary sheet, reviewing selected concepts, followed each lesson. One hundred Ss studied these lessons at the rate of one lesson per day for 22 days. The 52 Ss receiving Treatment W studied the 22 programed lessons and, in addition, completed a worksheet at the end of each lesson. This worksheet consisted of exercises which were handed in, corrected, and returned to the student. Group WO did the lessons and summary sheet but did not receive the worksheet.

The control group (C) received no instruction in grammar or composition; the teachers agreed to delay any teaching of grammar or composition until the completion of the experiment. In School A, control classes studied literature; in School B, they studied speaking.

Table 1

Kuhlmann-Anderson IQ Scores and Number of Ss for Each Group

Group	School A		School B		
	Male	Female	Male	Female	All Ss
Treatment W					
IQ	109	117	115	115	114
No. of Ss	11	15	13	13	52
Treatment WO					
IQ	103	117	115	112	112
No. of Ss	12	15	11	10	48
Control					
IQ	109	116	114	114	113
No. of Ss	24	25	31	27	107

The experiment required a total of 26 school days, including time for the lessons and related tests. Four separate tests were given: a pretest before Lesson 1, a posttest after Lesson 10, another pretest before Lesson 11, and a final posttest after Lesson 22.

Classroom Methods

At the beginning of each class period, the day's lesson was distributed to the experimental group. In addition to the programed material, one-half of each class also received the worksheet at this time. Lessons were stored in cumulative folders which were available to the students for reference and review. Students who were absent made up work when they returned and were given school time to work in study halls if needed. These conditions permitted nearly simultaneous testing for all classes in both schools.

Students proceeded at their individual rates. Teachers were advised not to offer help with concepts and processes taught in the lessons. However, teachers could help students with possible difficulties in reading or pronouncing words. Teachers were told, "If the word is in a sample sentence, you may help the student with meaning. If the word pertains to one of the concepts in the program, and if the students are unclear about its meaning, you may refer them back to the frame or lesson where it was introduced." Teachers were free to give as much help as necessary with the mechanics of the programed approach.

In working with the programed lessons, students were instructed to cover the correct printed response with their answer sheet and to reveal this response as soon as they had written their own. Information on the relative difficulty of the frames was obtained since students did not erase incorrect answers but were asked to draw a line through them and write the correct answer immediately next to the one crossed out.

Students who were in the group receiving worksheets (W) completed these in class and handed them to the teacher at the end of the hour. Those students who did not have the worksheets (WO) were allowed to spend the remaining time studying. Teachers read the worksheets from each class as soon as possible, wrote favorable and encouraging comments on the worksheets, and helped the student understand his errors. Before working through each lesson, Group W students had the opportunity to look over the worksheets from the preceding day.

Format of Programed Lessons

The programing technique used in the lessons was essentially "linear," with information presented in a series of small, carefully sequenced frames. Each frame offered the student a chance to respond either to a question, a blank, or a multiple-choice format. Correct responses appeared in a separate column immediately to the right of the frames. Students wrote their own responses on a separate answer sheet, which served as a shield for covering the printed responses. The average number of frames per lesson was 60, although the exact length of a single lesson varied from 50 to 70 frames. No lesson, however, demanded more than one class period of the student's time.

Content of Programed Lessons

The 22 programed lessons had been developed and tested previously. The pilot-testing of the lessons was by 8 eighth graders who worked

through the lessons in individual sessions with the investigators and assistants. Wherever these students experienced difficulty in learning the materials, frames and entire lessons were revised. In the summer of 1966, the lessons were again tested with 59 eighth graders who participated in an experiment for 2 hours each morning for 5 weeks (Blount et al., 1967).

From the 1966 field-testing, the investigators learned that the length of the lessons was suitable for practical classroom use and that the lessons held the interest of both the fast and slow student. Also, 93% of the students indicated that they did not consider the vocabulary of the lessons difficult; 86% said they preferred working with the programed approach rather than with a standard textbook format. The average amount of time required for each lesson was 21 minutes; times for individuals ranged from 12 to 35 minutes. Of the responses made to the frames, 7.3% were incorrect. This error rate was acceptable for a linear program, although particularly difficult frames were again revised. A calculation of the average error rate for each lesson showed that the error rate was relatively consistent across lessons, neither increasing or decreasing systematically.

Lessons 1 through 10 presented nine basic sentence patterns and the main structures of a basic sentence: noun phrase, verb phrase, noun, noun marker, forms of be, verb, verb markers, completer, adjective, adverb, and prepositional phrase. The basic patterns were as follows and were introduced in this order:

1. NP + be + NP
2. NP + be + adj
3. NP + be + adv
4. NP + V
5. NP + V + NP
6. NP + Vs + adj
7. NP + Vb + adj/NP
8. NP + V + NP + NP
9. NP + V + NP + adj/NP

Lessons 11 through 22 introduced the concept of transform and explained the processes for constructing relative clauses, possessive noun phrases, passive sentences, phrases to expand a noun phrase, prenoun modifiers, appositives, noun clauses, and two kinds of verb-form nominals. The labels given to the nine transforms were abbreviated in the lessons, and lengthy algebraic transform rules were avoided in preference to verbal explanations and examples. Appendix A contains a general outline of the 22 lessons.

Format of Worksheet

The worksheets for Treatment W contained exercises designed to help the student apply the concepts and processes learned in each programed lesson. Labeling and parsing of sentence parts were avoided. Instead, some exercises asked the student to create his own sentences or parts of sentences. Other exercises required the combination of two or more sentences using a specified transformation, or the completion of a sentence using a particular structure. In the last ten lessons the worksheets included explanations of how the student could apply his knowledge to his own writing and showed that choices were open to him when writing. Examples of the kinds of exercises included in the worksheets are shown in Appendix B.

Format of Summary Sheet

Following each lesson Groups W and WO received a summary sheet reviewing the main concepts in the lesson. Grammatical terms introduced in the lesson were summarized and additional examples of concepts and structures were also given. The summary sheets sometimes included sentence tree diagrams to review graphically the relationships among sentence structures. Appendix C contains the summary sheet for Lesson 1.

Program Measures and Questionnaire

The Ss wrote their responses to each frame on a separate answer sheet. In addition to instructional functions, this answer sheet had two administrative purposes. It contained a record of the time required to work through each lesson and of the errors made on each individual frame. The Ss recorded time at the beginning and end of each lesson. Teachers emphasized that time was recorded only to give information on the length of the lessons and not to measure the speed of the students. Teachers asked the students to cross out incorrect responses instead of erasing them. Tabulating these errors gave the investigators some indication of the difficult frames which might require revision.

A 20-item questionnaire (Appendix D) was given to all treatment groups after completion of the 22 programed lessons. These questions asked for opinions on the lessons, worksheets, and summary sheets.

Collection of Writing Samples

During a period of five weeks immediately before the treatment, and again immediately after treatment, each student in both the treatment and control groups wrote a 1000-word prose writing sample. Usually, three or four themes were required to obtain 1000 words. Although all 207 students wrote 1000-word samples, the themes used in the analysis were from

114 students randomly selected from stratified groups. Neither the teachers nor the students were told which Ss had been selected. The original manuscripts from each student were Xeroxed and returned intact to the teachers for classroom use after the experiment. From the Xerox duplicate, typists made legible copy for analysis.

III

OBJECTIVE TESTS AND PROGRAM MEASURES

Because Lessons 1 through 10 consisted of material on sentence patterns and Lessons 11 through 22 were on sentence transforms, separate tests were constructed for patterns and transforms. Test I tested the knowledge of patterns and Test II tested transforms. Test II contained two sentence-combining problems which were analyzed separately as Test III. Tests were used both as pretests and as posttests. The pretests were analyzed for significant effects due to sex and treatment group. The posttests were analyzed several ways to determine the effects of sex, treatment, ability, and school, using KAT score and/or pretest score as covariates.

OBJECTIVE TESTS

Description

The tests were given by the teachers to all groups. The first test was used as a pretest before Lesson 1 and as a posttest after Lesson 10. The second test was used as a pretest before Lesson 11 and as a posttest after Lesson 22. Most of the items were reliable and discriminated well when used on previous occasions (Blount et al., 1967). Test I contained 35 four-option multiple-choice items and 15 completion items. Test II had 35 four-option multiple-choice items, 10 completion items, and two problems in sentence-combining. These latter two problems were treated as a separate test in this report although they were given Ss as part of Test II.

In each sentence-combining problem, the S was asked to combine a series of short basic sentences into a longer sentence retaining the same information and adding no new information. The students were not told specifically to make a single sentence although the short sentences comprising each item could easily have been reworked into one longer sentence through deletion, embedding, and substitution. The choice of how many sentences to write and what kinds of structures to include was left to the student. The basic sentences which the students were asked to combine were:

Problem One
- The truck eased around the corner.
- The truck was carrying logs.
- The logs were pine.
- The corner was sharp.

Problem Two
- The bear snarled at the hunters.
- The bear was black.
- The bear was protecting her cubs.
- The hunters were unfriendly.
- The hunters were walking toward her.

As shown by Hunt (1965), T-unit length and clause length are the two most reliable indexes of growth in sentence maturity. An increase in clause length is attributable to an increase in less-than-clause structures placed in the sentence through deletion and embedding. T-unit length reflects these processes, too, but is also affected by an increase or decrease in the number of subordinate clauses. Since the purpose of the sentence-combining tasks was to test deletion and embedding, clause length was chosen to evaluate performance more directly.

If a student used all of the possibilities for deletion and embedding in the two sets of kernel sentences, he might write these two transform sentences:

The truck carrying pine logs eased around the sharp corner.

The black bear, protecting her cubs, snarled at the unfriendly hunters walking toward her.

Thus, the maximum clause length would be 10 and 14 words, respectively.

Analysis

The pretests and posttests were analyzed as follows:

a. An analysis of covariance of the pretests and posttests employed a 2 x 3 factorial design with 23 Ss per cell (total N = 138). The covariate was KAT score. The factors were sex—male or female; and treatment—W, WO, or C.

b. An analysis of covariance of the posttests using a 2 x 2 x 3 x 2 factorial design included all 207 Ss and, necessarily, had unequal numbers in each cell. The covariate was pretest score. The factors were sex—male or female; school—A or B; ability—low, medium, or high (90-106, 107-118, or 119-145 on the KAT); and treatment—experimental or control.

c. Another analysis of covariance of the posttests employed a 2 x 2 x 3 factorial design with 12 Ss per cell (total N = 144). The covariates were KAT score and pretest score. The factors were sex—male or female; school—A or B; and treatment—W, WO, or C. An analysis of the sum of Posttests I and II was made with this same design, using the KAT score and the sum of Pretest I and II as the covariates.

Pretest Results

For purposes of analysis, the two sentence-combining problems were analyzed as Test III. Each of the three pretests (I, II, and III) was analyzed for significant effects in a 2 x 3 analysis of covariance with 23 Ss per cell (N = 138). The covariate was KAT score and the factors were sex and treatment. Table 2 contains the means and standard deviations of the pretest scores. No significant differences were noted between the W, WO, and C groups on any of the pretests. Females scored higher on Pretest I and II than males ($p < .01$); and they also scored higher than males on Pretest III ($p < .05$). Thus, in initial knowledge of grammar and in ability to combine sentences, the females were more advanced than males, but no differences existed between the control and experimental groups.

Posttest Results

The three posttests (I, II, and III) were analyzed with the same design and the same Ss as that used for the pretests. In addition, two other designs were used so that an adequate picture of the results could be obtained. In almost every case, the posttests revealed that groups WO and W learned a great deal more than the control groups.

Table 2

The Observed Mean Number of Items Correct and the Standard Deviations on the Pretests and Posttests (N = 138)

Test	Grand (138)	Male (69)	Female (69)	W (46)	WO (46)	C (46)
Pretest I						
$\bar{X}$	25.1	22.4	27.8	24.3	23.6	27.4
σ	9.1	8.8	8.6	8.6	8.4	9.9
Pretest II						
$\bar{X}$	20.9	18.4	23.5	21.0	21.1	20.8
σ	7.3	6.7	7.0	7.4	7.2	7.4
Pretest III						
$\bar{X}$	15.8	14.4	17.2	14.5	16.0	17.0
σ	6.3	6.9	5.3	6.9	6.5	5.1
Posttest I						
$\bar{X}$	30.8	27.6	34.0	32.1	31.4	29.0
σ	9.9	9.7	9.2	9.9	9.8	10.1
Posttest II						
$\bar{X}$	24.3	21.0	27.5	25.4	25.1	22.4
σ	8.6	8.0	7.9	8.8	9.5	7.1
Posttest III						
$\bar{X}$	17.5	16.6	18.5	17.3	18.8	16.5
σ	6.2	6.9	5.4	6.7	4.9	6.8

Posttest I. The initial analysis showed both sex and treatment to be significant. Females were above males on mean score ($p < .01$), and Groups W and WO were each significantly higher than the control group ($p < .05$ by Newman-Keuls analysis). Table 2 shows the relevant means of this analysis. Note that the improvement from Pretest I to Posttest I for the two Groups W and WO was about 8 points as compared to less than 2 points for Group C.

In a second analysis of Posttest I, all 207 Ss were used. This analysis tested not only the effects of sex and treatment but also possible differences due to ability and school. The results are summarized in Tables 3 and 4. The score on Pretest I was used as a covariate, and, as a result, effects attributed to sex in the previous analysis disappeared. Though females were at a higher level when entering the experiment than males, there were not differential learning increases. Both sexes retained the same relative standing at the close of the experiment as had been noted at the start. Groups W and WO were considered as one group in the comparisons with Group C. The 100 Ss in the experimental groups had a mean score of 31.9 on Posttest I, while the control group scored 26.9, a difference that was significant ($p < .001$).

Table 3

Score on Posttest I Using Pretest I as the Covariate

2 x 3 x 2 x 2 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	3840.08	182	--	--
Regression	5373.39	1	254.67	.001
Treatment (T)	1799.77	1	85.30	.001
IQ	320.15	2	7.59	.001
Sex	46.41	1	2.20	ns
School (S)	156.24	1	7.40	.007
T x IQ	60.22	2	1.43	ns
T x Sex	21.20	1	1.00	ns
T x S	151.53	1	7.18	.008
IQ x Sex	2.98	2	0.07	ns
IQ x S	40.78	2	0.97	ns
Sex x S	4.42	1	0.21	ns
T x IQ x Sex	72.29	2	1.71	ns
T x IQ x S	37.53	2	0.89	ns
T x Sex x S	6.51	1	0.31	ns
IQ x Sex x S	5.34	2	0.13	ns
T x IQ x Sex x S	83.22	2	1.97	ns

Raw Regression Coefficient: +.79

Table 4

Means and Adjusted Contrasts for Posttest I Using Pretest I as the Covariate

Factor	Level	Means Pre	Means Post	Contrast $(x' - \bar{x}')$
Treatment				
100	Experimental	24.2	31.9	+ 3.18
107	Control	25.9	26.9	- 3.18
IQ				
65	Low	18.4	22.7	- 2.12
75	Medium	24.8	28.6	+ .08
67	High	31.8	37.2	+ 2.04
Sex				
102	Male	23.0	27.0	- .36
105	Female	27.1	32.0	+ .36
School				
102	A	24.3	29.9	+ 1.02
105	B	25.8	29.1	- 1.02
Interaction				
Treatment x School				
53	Exp. A	23.8	33.1	+ 5.24
47	Exp. B	24.6	30.6	+ 1.12
49	Control A	24.8	26.5	- 3.20
58	Control B	26.7	28.0	- 3.16

Though males and females showed equal gains, the different ability levels experienced differential learning increases. As shown in Table 4, the high group was superior to the medium group, which in turn scored higher than the low group. Newman-Keuls comparison of means showed that the differences between all groups were significant. Pretest I score was used as a covariate, and thus the significant differences represent increases over and above the linear effect of prior knowledge. The high group increased an average of 5.4 points from Pretest I to Posttest I compared to an increase of 3.8 for the medium group and 4.3 for the low group ($p < .05$).

Another significant effect in the analysis of Posttest I was the school variable. The students in School A were superior ($p < .01$) on Posttest I to the School B students. Since the linear effect of pretest score was removed, the difference reflects more gain for School A than for School B. Table 4 shows these pretest and posttest differences. The factor of school interacted significantly with treatment ($p < .01$), as shown by the contrasts in Table 4. The experimental Ss in School A advanced to a higher level of knowledge than the experimental Ss in School B, while both control groups showed only small advances. Newman-Keuls comparison of means showed that the experimental group in School A was higher than the experimental group in School B (Exp. B) and the control groups ($p < .01$), and that Exp. B was higher than both control groups ($p < .01$).

Whether or not the experimental groups themselves differed from one another on test scores was answered by the third analysis of covariance of Posttest I. With KAT score and pretest score as covariates and considering all three groups, W, WO, and C, the treatment effect was significant at the .001 level. Newman-Keuls comparison of the three adjusted means for Groups W, WO, and C (32.5, 32.4, and 26.6, respectively) showed that Groups W and WO were significantly higher ($p < .01$) than Group C, but that there were no differences between Groups W and WO.

Posttest II. The pattern of differences between groups was much the same on Posttest II as it had been on Posttest I. The first analysis, in which KAT score was the covariate and sex and treatments were the factors, showed that females scored higher than males ($p < .01$) and that Groups W and WO scored higher than Group C ($p < .01$ by Newman-Keuls comparison). The means from this analysis are presented in Table 2.

In Table 5 the summary of the second analysis of covariance is presented. The effects of treatment, ability, and sex were significant ($p < .01$). Table 6 shows that females were higher than males and that the experimental groups were higher than the control groups. The medium and high ability groups learned more than the low ability group ($p < .01$ by Newman-Keuls comparison). The regression of pretest score to posttest score was significant ($p < .001$).

Table 5

Score on Posttest II Using Pretest II as the Covariate

2 x 3 x 2 x 2 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	3275.68	182	--	--
Regression	3461.39	1	192.32	.001
Treatment (T)	662.73	1	36.82	.001
IQ	189.32	2	5.26	.006
Sex	161.60	1	8.98	.003
School (S)	47.69	1	2.65	.105
T x IQ	12.13	2	0.34	ns
T x Sex	9.37	1	0.52	ns
T x S	46.01	1	2.56	ns
IQ x Sex	86.95	2	2.42	.092
IQ x S	61.00	2	1.70	ns
Sex x S	0.81	1	0.04	ns
T x IQ x Sex	10.09	2	0.28	ns
T x IQ x S	53.51	2	1.49	ns
T x Sex x S	31.10	1	1.73	ns
IQ x Sex x S	8.45	2	0.24	ns
T x IQ x Sex x S	1.38	2	0.04	ns

Raw Regression Coefficient: +.85

The third analysis, which used 144 Ss in a 3 x 2 x 2 design that tested Groups W, WO, and C, showed that, with the linear effect of both pretest score and KAT score removed, Groups W and WO were significantly higher than Group C ($p < .01$ by Newman-Keuls comparison). No significant differences existed between Groups W and WO. With KAT and pretest as covariates, sex ($p < .05$) and school ($p < .01$) were significant; females were higher than males, and School A Ss higher than School B Ss.

Posttest I and II Combined The scores of the two posttests were combined and analyzed using the 3 x 2 x 2 covariance design which employed two covariates (KAT and combined pretest scores), 144 Ss, and the factors treatment, school, and sex. The summary of this analysis is described in Table 7, and the relevant means and contrasts are in Table 8.

Posttests I and II in combination provided a good indication of the total amount of concept

Table 6

Means and Adjusted Contrasts for Posttest II
Using Pretest II as the Covariate

Factor	Level	Means Pre	Means Post	Contrast ($x' - \bar{x}'$)
Treatment				
100	Experimental	21.1	25.4	+ 1.91
107	Control	19.9	20.8	- 1.91
IQ				
65	Low	15.8	17.7	- 1.83
75	Medium	19.7	22.6	+ .90
67	High	25.8	28.7	+ .94
Sex				
102	Male	18.7	20.3	- .81
105	Female	22.2	25.7	+ .81
School				
102	A	20.4	23.5	+ .62
105	B	20.5	22.6	- .62

Table 7

Analysis of Covariance of the Sum of Posttests I and II Using KAT Score and Pretest I and II Scores as Covariates

3 x 2 x 2 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	5060.8	130	--	--
Regression	25083.8	2	322.17	.001
Treatment (T)	3004.9	2	38.60	.001
School (SC)	578.6	1	14.86	.001
Sex (S)	209.0	1	5.37	.022
T x SC	434.4	2	5.58	.005
T x S	26.1	2	0.34	ns
SC x S	10.5	1	0.27	ns
T x SC x S	41.9	2	0.54	ns

Raw Regression Coefficients: KAT +.18
Pretest +.94

learning achieved by Ss. The items tested all the major concepts in the program. The results indicated a highly significant treatment effect in favor of Groups W and WO over Group C. Also significant were the effects of sex ($p < .05$, with females higher than males) and school ($p < .001$, with A higher than B). Treatment and school showed a significant interaction ($p < .01$) which, as the contrasts in Table 8 show, could be interpreted as due to the gains of the Ss in School A in using the experimental treatments.

Posttest III. The preliminary analysis of the two sentence-combining tasks showed no significant effects for sex or treatment. However, when the Pretest III score was used as a covariate, several significant effects were revealed, as shown in Table 9. Ss in the experimental groups combined sentences more maturely than those in the control group ($p < .05$). Ss in School A were significantly above Ss in School B in sentence combining ($p < .001$). Table 10 shows the relevant means for the main effects and for the two significant interactions. The contrasts and means show that in each interaction one group of Ss scored quite low in relation to the other groups.

Test Item Analysis

Test I contained 35 multiple-choice items and 15 completion items. Test II contained 35 multiple-choice items and 10 completion items. Test III consisted of two sentence-combining problems. The responses from the 100 students in Groups W and WO were used for an analysis of items. All multiple-choice and completion items on Tests I and II were analyzed by the simplified test analysis procedure described by Stanley (1964). The nature of the sentence-combining problems of Test III did not permit item analysis. In the Stanley procedure, the top 27% of the scores are compared to the bottom 27% to obtain a measure of discrimination for each item. The discrimination index of an item is the number of times it was answered incorrectly by the low 27% minus the number of times it was missed by the high 27%. Thus, an index of 12 would imply that

Table 8

Means and Adjusted Contrasts for the Sum of Posttest I and II
Using KAT Score and Pretest I and II as Covariates

Factor	Level	Means Pre	Means Post	Contrast $(x' - \bar{x}')$
Treatment				
48	Without	44.65	56.25	+ 2.86
48	With	46.00	58.90	+ 3.58
48	Control	45.15	47.62	- 6.45
School				
72	A	43.58	54.38	+ 2.03
72	B	46.95	54.18	- 2.03
Sex				
72	Male	40.40	48.00	- 1.30
72	Female	50.13	60.58	+ 1.30
Treatment x School				
24	Without A	43.00	58.38	+ 7.04
24	Without B	46.30	54.12	- 1.32
24	With A	45.90	60.58	+ 5.59
24	With B	46.10	57.20	+ 1.57
24	Control A	41.85	44.21	- 6.55
24	Control B	48.45	51.25	- 6.35

Table 9

Score on Posttest III Using Pretest III
as the Covariate

2 x 3 x 2 x 2 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	5384.52	182	--	--
Regression	741.51	1	25.06	.001
Treatment (T)	129.99	1	4.39	.037
IQ	163.78	2	2.77	.065
Sex	12.81	1	0.43	ns
School (S)	323.65	1	10.94	.001
T x IQ	183.20	2	3.10	.048
T x Sex	12.72	1	0.43	ns
T x S	24.75	1	0.84	ns
IQ x Sex	30.67	2	0.52	ns
IQ x S	210.29	2	3.55	.031
Sex x S	19.99	1	0.68	ns
T x IQ x Sex	29.18	2	0.49	ns
T x IQ x S	1.73	2	0.03	ns
T x Sex x S	12.55	1	0.42	ns
IQ x Sex x S	13.51	2	0.23	ns
T x IQ x Sex x S	3.72	2	0.06	ns

Raw Regression Coefficient +.35

twelve more low scorers than high scorers got an item wrong.

The multiple-choice items of Test I, when used in the pretest, had a mean discrimination index of 13.7; the completion items had a mean discrimination index of 19.9. As a posttest, these same items showed discrimination indexes of 18.3 for the multiple-choice items and 20.0 for the completion items.

The multiple-choice items of Test II, when used in the pretest, had a mean discrimination index of 12.3; the completion items, 19.9. On the posttest these same items had mean discrimination indexes of 15.9 and 21.7, respectively.

E. V. Piers (Stanley, 1964) calculated that for four options and 100 Ss a discrimination index of 8 or higher on an individual item is significant at the .025 level. The percent of items reaching or exceeding this criterion of 8 is summarized in Table 11. A very high percentage of the items discriminated significantly between high and low scorers.

PROGRAM MEASURES

Errors

To assess the difficulty of the lessons and to identify ambiguous or otherwise poor frames, assistants recorded and compiled the errors found on each student's response sheet. Table 12 gives the total number of errors and the mean error rate for two ability groups, those Ss above the median score (113) on KAT and

Table 10

Means and Adjusted Contrasts for Posttest III
Using Pretest III as the Covariate

Factor	Level	Means Pre	Means Post	Contrast $(x' - \bar{x}')$
Treatment				
100	Experimental	15.3	18.0	+ .87
107	Control	15.9	16.6	- .87
IQ				
65	Low	11.8	14.6	- 2.09
75	Medium	16.3	17.7	+ .83
67	High	18.6	19.3	+ 1.26
Sex				
102	Male	14.7	16.5	- .91
105	Female	16.5	18.0	+ .91
School				
102	A	14.1	17.9	+ 1.31
105	B	17.1	16.6	- 1.31
Interaction				
Treatment x IQ				
36	Exp. Low	11.1	16.4	+ .06
28	Exp. Med.	17.3	18.3	+ 1.18
36	Exp. High	17.9	19.2	+ 1.37
29	Control Low	12.6	12.3	- 4.24
47	Control Med.	15.7	17.4	+ .48
31	Control High	19.3	19.4	+ 1.15
IQ x School				
41	Low A	11.0	16.5	+ .67
24	Low B	13.1	11.3	- 4.85
26	Med. A	14.1	18.0	+ 1.76
49	Med. B	17.5	17.6	- .10
35	High A	17.8	19.5	+ 1.50
32	High B	19.5	19.1	+ 1.02

Table 11

Percent of Items with a Discrimination Index Significant at .025

Item Type	Test I Pretest	Test I Posttest	Test II Pretest	Test II Posttest
Multiple-choice	86	100	80	90
Completion	100	100	100	90

those below 113 on KAT. The mean error rate, errors per 100 responses, was generally at a low level. The overall error rate for the higher ability group was 1.13, for the lower ability group, 2.34. The highest error rate for both the high and low Ss occurred on Lesson 14, concerning the related clause with whose, a two-transform process. There was no consistent relationship between lesson length, content, and error rate.

All frames answered incorrectly by six or more Ss were marked for revision. From a total of 1,328 frames, 14.5% of the frames elicited incorrect responses from 6 or more students and were subsequently revised; 60.5% elicited incorrect responses from 1 to 5 students; and 25% elicited no incorrect responses.

Table 12

Number of Errors, Errors per 100 Responses, and Time for Each Lesson

Lesson Number and Content	Number of Frames	Number of Errors	Errors per 100 Responses		Average Time in Minutes	
			High Ability Ss	Low Ability Ss	High	Low
Lesson 1: A Look at Basic Sentences	60	75	.61	1.30	22	27
Lesson 2: Basic Sentence Patterns 1 and 2	60	124	1.36	1.92	22	26
Lesson 3: Basic Sentence Pattern 3 and Review	65	148	.69	2.66	22	27
Lesson 4: Basic Sentence Pattern 4	60	96	.65	1.99	20	22
Lesson 5: More About Nouns	65	119	.94	1.88	20	23
Lesson 6: Recognizing Verbs	87	206	.82	2.69	26	28
Lesson 7: Recognizing Adverbs	52	116	1.37	2.13	16	19
Lesson 8: Adjectives with Patterns 5 and 6	75	209	1.50	2.81	22	23
Lesson 9: Basic Sentence Patterns 7 and 8	64	131	1.21	1.99	19	19
Lesson 10: Basic Sentence Pattern 9 and General Review	55	142	1.52	2.52	19	20
Lesson 11: Introduction to Transform Sentences and Related Clauses	52	90	.78	1.84	16	16
Lesson 12: T-rel (related clause)	55	110	1.11	1.99	18	18
Lesson 13: T-rel Again	65	136	1.13	2.11	22	22
Lesson 14: T-rel after T-pos (possessive construction)	55	338	2.75	6.58	18	18
Lesson 15: T-pass (passive construction)	50	106	1.10	2.16	16	18
Lesson 16: T-ph (participial phrases)	55	123	.93	2.44	17	19
Lesson 17: T-BN (single words before the noun)	60	131	.95	2.35	21	19
Lesson 18: T-NP and Double Nouns (appositives, noun adjuncts)	62	112	.86	1.90	19	20
Lesson 19: T-NC (noun clause)	70	172	1.31	2.49	20	20
Lesson 20: T-V_{to} (V_{to} nominals)	65	110	.85	1.75	18	19
Lesson 21: T-V_{ing} (-ing nominals)	50	110	.98	2.36	14	16
Lesson 22: Adj and Adv Nominals and Review of Nominals	46	102	1.82	1.82	14	15
TOTAL	1328	3006	--	--	421	454
MEAN	60.4	136.6	1.13	2.34	19.1	20.6

Time

The overall average time required to complete a lesson was 19.1 and 20.6 minutes for the upper and lower ability groups, respectively. The range extended from 13 to 26 minutes for the high group and from 13 to 30 minutes for the low. The Pearson product-moment correlation between length of lesson and average time was +.79. The time required to work through each lesson is shown in Table 12.

QUESTIONNAIRE

The questionnaire concerned the general suitability of the lessons for practical classroom use. Over one-half of the students thought the length of the lessons was just right. Most of the remaining students considered them too long, despite the low average time of 20 minutes. Very few students thought the pace of one lesson per day too fast; most considered it a comfortable pace. About two-thirds of the

students reported quite candidly that they revealed correct responses from 1 to 3 times a lesson, 20% said they did so more than 3 times, and 13% said they never revealed the correct response before writing it. Very few found the vocabulary difficult; 62% thought it very easy. Most students thought the summary sheet was helpful, and the majority of students referred to the previous lessons for review. Almost all students receiving the worksheets after each lesson reported that they found the worksheets helpful in understanding the lesson better and in realizing how they could apply what was taught in that lesson.

Although interest in the lessons generally was moderate, 90% indicated that the new approach was more interesting than the traditional, and 96% thought the new approach would be more helpful to them. Table 13 shows the responses to the question, To what degree do you feel that what you learned about the following things will be helpful to you in the future? Students were asked to rank seven concepts and transforms in order of decreasing difficulty. Table 14 summarizes the responses of the students who answered this item. One can conclude from the

Table 13

Responses to the Question, To what degree do you feel that what you learned about the following things will be helpful to you in the future?

Content being rated	Rating		
	Very helpful	Somewhat helpful	Not helpful
Basic sentences	39.3%	55.4%	5.3%
Test-sentences	47.3	45.5	7.2
Clues for recognizing a noun, verb, adj., adv.	64.3	30.4	5.3
Transform processes for combining shorter sentences to expand an NP (T-rel, T-BN, T-ph, T-NP, etc.)	41.1	40.2	18.7
Transform processes for making nominals (T-NC, $T\text{-}V_{to}$, $T\text{-}V_{ing}$)	28.6	54.4	17.0

Table 14

Students' Ranking of the Difficulty of Seven Concepts

Concept	Rank of Difficulty								
	Difficult							Easy	Average
	1	2	3	4	5	6	7	8	rank
Subject and predicate groups	3	3	1	3	2	15	35	38	6.73
Basic sentence patterns	10	7	7	4	5	34	36	7	5.33
T-rel	7	12	19	20	30	7	5	0	3.95
T-BN (pre-noun modifiers)	8	24	24	7	21	7	8	1	3.67
$T\text{-}V_{to}$ (infinitive nominals)	23	17	8	15	17	10	7	3	3.59
T-NC (noun clause)	14	17	16	25	14	13	2	0	3.58
T-pass	18	18	22	22	9	6	3	2	3.23

students' responses that the lessons covering the basic sentence patterns and sentence structures (Lessons 1-10) were the easiest, and that transforms were considered more difficult. There was not enough concensus to indicate one transform as being more difficult than another.

Students were asked to rank four alternate modes of presenting material:

A Programed lessons alone
B Programed lessons with teacher's help
C Standard textbook form
D Teacher lecturing

The responses of the 78 students answering this question are summarized in Table 15. The preferred mode was the programed approach with teacher's help; the method preferred least was teacher lecturing.

Table 15

Student Rank of Four Modes of Presentation

Mode	Rank				Average rank
	Best 1	2	3	Worst 4	
A Programed lessons alone	17	37	13	11	2.23
B Programed lessons with teacher help	43	20	15	0	1.64
C Standard textbook	13	16	35	14	2.73
D Teacher lecture	5	5	15	53	3.48

IV
WRITING SAMPLES

PROCEDURES

Themes totaling approximately 1000 words were written by each student before and after the experiment. Prewriting samples were collected over a period of five weeks preceding the experiment. The postwriting samples were collected during the five weeks following the experiment. Pre- and postwriting samples of 114 Ss were scored for the number of sentences, T-units, clauses, and words and for kinds of subordinate clauses used. These scores were analyzed to test whether treatment, ability, sex, or school had significant effects upon writing.

Specifications for Writing Samples

In specifying topics for the student themes, the teachers were urged to avoid topics which would prompt a great deal of direct discourse since sentences of this type would be eliminated before analysis. In some cases the Ss were given a list of possible narrative and expository topics and were allowed to choose those which appealed to them most. The topics eventually used were as follows:

Prewriting

1. Desirable changes at school
2. Future plans and goals
3. Narrative about an event
4. Description of someone
5. A typical school day

Postwriting

1. Best time of year
2. Desirable changes at home
3. Description of a pet
4. Narrative about a trip
5. Defense of special programs at school

Exclusion of Certain Kinds of Sentences

Hunt (n.d.), in his report on the sentence structures of superior fourth- and twelfth-grade students and superior adults, made certain procedural recommendations as to what to omit when analyzing sentences. Relying on these recommendations, the present investigators omitted the following items from the writing samples before totaling the 1000 words:

1. Sentence fragments and unintelligible structures.
2. All direct discourse. (If direct discourse had been included, the immature writer would be credited with an abundance of noun clauses, and his overall clause length would decrease due to the presence of many abnormally short clauses such as "Mary said.")
3. Imperatives and questions. (These occur too infrequently in writing to influence the statistical analyses significantly.)

In addition, sentences containing direct quotations were also eliminated because direct quotations reflect the syntactic ability of some writer other than the student.

Working Definitions

The investigators used Hunt's definitions of sentence, clause, and T-unit in deciding what structures would be tabulated as such. A sentence was defined as "the words written between a capital letter and a period or other terminal punctuation." A clause was "a structure containing a subject (or coordinated subjects) and a finite verb phrase (or coordinated verbs or phrases)." T-unit, or "minimal terminable unit," was defined as "one main clause plus the subordinate clauses attached to or embedded within it [Hunt, 1965, p. 49]."

A T-unit is the shortest grammatically allowable unit into which a sentence can be segmented without producing sentence fragments. Every sentence contains at least one T-unit, but it may have more. Every T-unit has at least a main clause and may have several subordinate clauses. T-units within sentences are usually coordinated with and, but, or or so. The coordinator must be followed by a clause having a subject and finite verb.

The word so required special attention because it has two very different functions. Used one way the word means (and) so; used another, so (that). (And) so begins a T-unit; but so (that) signals a subordinate adverb clause, as in the T-unit". . . and I would start on another job so people couldn't call me a lazy man." Here the writer clearly means so that. At other times, when the ambiguous so could understandably be either possibility, the decision was made subjectively.

The following sentence, written by an eighth grader, contains three T-units (marked by double slashes) each of which could stand alone as a grammatically complete structure. In addition to the main clauses, two of the T-units have a subordinate clause (marked by a single slash and an abbreviation).

If I had a million dollars^{adv}/I think^{N}/that I would do a lot of things//
but I would put most of the money in the bank//
and I would start on another job^{adv}/so people couldn't call me a lazy man//

A definition of word was also needed to avoid large discrepancies in the actual word count of the writing samples. Decisions on whether to count a structure as one word or two (no matter how the Ss had written it) were made by referring to Webster's Seventh New Collegiate Dictionary, 1965. The investigators were advised by Hunt[1] to consider all contractions as two words since they would be written out in formal writing. Also, all proper nouns, regardless of their "actual" word count, were tabulated as one word. Consequently, terms like Mr. Grimm, Joe, and Yellowstone National Park were counted as one word.

Identifying and Tabulating T-units and Clauses

To facilitate the analysis of T-units and clauses, the 1000-word samples were typed exactly as S had written them. Typists were instructed not to correct misspellings and punctuation, not to add words which were carelessly omitted, and not to delete words which the writer himself had not deleted. The first process of breaking each writing sample into sentences was accomplished simultaneously with the typing. The typists were told to number each sentence consecutively and to consider as a sentence everything that appeared between a capital letter and terminal punctuation.

Working from the typed copies, two raters indicated the end of each T-unit with a double slash. Subordinate clauses were indicated by a single slash, and the type of clause was written immediately above. The subordinate clauses found in the writing samples were identified as the following kinds:

noun clauses
adjective clauses
adverb clauses
clauses of comparison
deferred subject construction
cleft sentence
subjunctive word order
clauses that complement an adjective
clauses that complement a verb like "seem"
the more, the merrier construction
special which construction

Most noun clauses occurred in the familiar nominal positions of subject, direct object, and object of a preposition. Another fairly common position was as an appositive after a noun. Here are several examples of the appositive noun clause:

It creates a feeling that we shall strive on.
The fact that there are good teenagers is never mentioned.
He stated the opinion that we should continue to fight.

Although on the surface these noun clauses seemed identical to adjective clauses in the same position, their deep structure, or derivation, was quite different. An easy test for an appositive noun clause is to place it in predicate nominal position after be:

A feeling is that we shall strive on.
The fact is that there are good teenagers.
The opinion is that we should continue to fight.

Adjective clauses will not function in the predicate nominal position, but appositive noun clauses will.

"Asides" such as I suppose and I think occurred relatively infrequently. In the sentence "I thought the party was disastrous," the clause following I thought was identified as a subordinate noun clause and I thought as the main clause.

[1] Personal interview with Kellogg W. Hunt, Madison, Wisconsin, June, 1966.

Clauses beginning with where and when may function as any of three frequently used clauses —adjective, adverb, or noun—depending upon their sentence position and movability. As adverb clauses they may be moved to different positions in the sentence without loss of meaning.

When I woke up, I heard noises outside the tent.
I heard noises outside the tent when I woke up.

A when clause functioning as a nominal was most likely to occur as the direct object after verbs like remember, imagine, and so on.

The sheriff remembered where he lost his keys.
I can imagine when they'll arrive.

Clauses in this position were analyzed as noun clauses. However, if the writer supplied the deletable noun of place or time before where or when, the clause then became an adjective clause, as in:

The sheriff remembered the place where he lost his keys.

As an adjective clause, where he lost his keys cannot be moved away from the noun phrase it expands without destroying the deep-structure relationships in the sentence.

Where he lost his keys, the sheriff remembered the place.

An example of the where or when clause used as an adjective clause can be seen in a sentence such as, "The fire occurred that time when they were gone." That time when they were gone is used as an adverbial of time, but the entire structure can be further analyzed as a noun phrase plus a clause. The clause itself functions as an adjective clause even though it does appear within a larger adverbial structure.

Clauses of comparison were tabulated separately rather than with the movable adverb clauses. Although some clauses of comparison were movable, as in "I left as soon as I could," most were very closely connected to a noun, adjective, or adverb and had a fixed sentence position. Here are several examples:

It got so dark that I was going to turn on my lantern.
You do a lot more than you did at the first of the year.
The clouds seemed so low that you could catch one.
They are so crowded that you can't walk up and down the steps.
We should have more dances than we had last year.
The bell made such a noise that I couldn't hear.

There were two kinds of clauses whose classification as an adverb clause or as a clause of comparison depended on the context of the sentence. These special cases were clauses beginning with as far as and as long as. When the writer intended the literal meaning of far and long, expressions of distance, length, or duration, the clauses were tabulated as clauses of comparison. But when the function of the structures was analogous to insofar as or if, they were considered adverb clauses.

As far as the Indians could see, buffalo crowded the prairie. (comparison)
As far as the jury is concerned, the prisoner is guilty. (adverb)
The dangling climber hung on as long as he could. (comparison)
She said I could go as long as I told her where. (adverb)

Some subordinate clauses appeared as a complement to an adjective, usually a predicate adjective relating to emotion or state of mind. These clauses could not be moved away from their position after the adjective:

I'm sorry (that) I didn't do better.
She was sure (that) I had left home.
The deputy was convinced (that) the car was stolen.

A very infrequent kind of complement clause occurred after a verb like seem, feel, appear, look, and so on. Here are some examples of this kind of clause:

The paragraph sounds like the author is against war.
She looked as if she had seen a ghost.
The director felt as though the tempo was too slow.

Occasionally a writer used the indefinite it, which had no referent, as the "grammatical" subject of the sentence. The "logical" subject followed later, sometimes in the form of a clause.

It was unfortunate that such an accident happened.
It's the fog that keeps the dirt and fumes from escaping.

Using the same terms which Hunt (1965) assigned to these structures, raters labeled the first sentence as a "deferred subject" sentence and the second as a "cleft" sentence. The difference between a sentence with a deferred subject and a cleft sentence is quite simple, theoretically. One can reposition the deferred subject clause as the grammatical subject, as in "That such an accident happened was unfortunate." to make an acceptable English

sentence. But one cannot say "That keeps the dirt and fumes from escaping is the fog."

The use of a different word order to express the subjunctive mood was very rare. Only one student wrote a sentence containing the subjunctive word order.

They would have killed each other had it not been for Mr. Napoleon.

"The more, the merrier" construction was used by some students, though relatively infrequently. Here are the sentences in which clauses of this type appeared.

And the fewer the days get, the more I think about it.
The more he worried, the more he felt sorry for himself.
The test shows that the more you move, the larger the growth gets.
The warmer the water, the farther down the fish will be.
The more they understand each other, the more they're able to get done.
But no rain, no food.
The more money I would have, the more things I could get.

The special which construction covers "which" clauses that modify an entire sentence or idea. A mature writer would probably use an adverbial clause instead. Some examples are:

I dislike school as a whole because you have to get up so early in the morning which cuts down on your sleep.
When we come in the morning we can go to the gym, which I think is nice.
School should end when grade school ends, which is about four o'clock.

Measures of Syntactic Growth

For each student's 1000 words of pre- and postwriting, the raters made 15 frequency counts which included the number of the eleven kinds of subordinate clauses and the number of sentences, T-units, clauses, and words. These last four were used for the computation of five synopsis factors. The five synopsis factors were words per sentence, words per T-unit, words per clause, T-units per sentence, and clauses per T-unit.

Although mature writers produce longer sentences than young children, sentence length as a measure of individual growth is relatively unreliable. Immature writers may produce sentences of extraordinary length because they are unskilled in punctuation and are more apt to connect a long string of main clauses with coordinators. The longest sentence found in the writing samples of this study consisted of 136 words, which is eight times longer than the average eighth-grader's sentence. But this sentence contained 11 main clauses connected with coordinators, commas, or simply no punctuation at all. Sentence length alone as an index of maturity would place this writer far ahead of his classmates who might be more skilled at punctuation and subordination. By breaking the sentence into its main clauses, or T-units, plus any attached subordinate clauses, one can compute more valid measures of maturity: T-unit length and clause length (Hunt, 1965).

Main clauses, or T-units, may be lengthened by adding subordinate clauses and by embedding less-than-clause structures. The amount of embedding a student does is reflected in his clause length, while the addition of subordinate clauses may be measured by the ratio of total clauses divided by total T-units. The ratio of clauses to T-units, called the "subordinate clause index," is an arithmetic link between clause length and T-unit length:

$$\frac{\text{words}}{\text{clauses}} \times \frac{\text{clauses}}{\text{T-units}} = \frac{\text{words}}{\text{T-units}}$$

A subordinate clause index of 1.8 indicates that 80% of the time a subordinate clause was included in the main clause. Because all T-units must contain at least one main clause, this index can never be less than 1.0 and is rarely greater than 2.0.

Another ratio, T-units per sentence, is the arithmetic link between T-unit length and sentence length and is known as the "main clause coordination index." This ratio is never less than 1.0 since each sentence has at least one T-unit or main clause. T-units per sentence is the only synopsis factor which decreases with increasing maturity (Hunt, 1965). Mature writers use less coordination between main clauses and more subordination and embedding.

Training of Raters

Two raters were trained to analyze the writing samples. They identified and marked T-units and subordinate clauses and assigned a label to each subordinate clause. In a two-week period they were taught to recognize the various kinds of clauses and to indicate the names of clauses with a standard notation, N for noun clause, comp for clauses of comparison, and so on. When their accuracy and speed showed that further training was not required, they analyzed the samples of eighth-grade writing independently.

To assure accuracy of the final counts and classifications for the writing samples used in the statistical analyses, a third person compared the notations on all papers after each rater had made independent analyses. Discrepancies in the two raters' tallies of words, clauses, T-units, and sentences were traced to the specific sentences, and errors were corrected. Disagreements in the classifications of types of subordinate clauses were resolved by the third person.

ANALYSIS

The 1000-word writing samples of 114 eighth graders were tabulated on the basis of 16 variables which included eleven different kinds of structures and five synopsis scores. The frequencies of seven structures were too infrequent to provide a rigorous basis for analysis of variance. Thus, only nine measures were analyzed:

1. Subordinate adjective clauses
2. Subordinate adverb clauses
3. Subordinate noun clauses
4. Clauses of comparison
5. Clause length
6. Clauses per T-unit
7. T-unit length
8. T-units per sentence
9. Sentence length

(5–9: five synopsis scores)

Those variables occurring too infrequently for statistical analysis were deferred subject, cleft sentence, subjunctive word order, clauses complementing an adjective or a verb like "seem," "the more the merrier" construction, and the special which clause.

Several analyses were made of the writing measures:

a. An analysis of covariance of nine prewriting measures and nine postwriting measures, a 2 x 2 x 3 factorial design with six Ss per cell (N = 72). The covariate was KAT score. The factors were sex—male or female; ability—above or below the median KAT score of 113; and treatment—W, WO, or C.

b. An analysis of covariance of nine postwriting measures using a 3 x 3 factorial design which included all 114 Ss and, necessarily, had unequal numbers per cell. The covariate was the equivalent prewriting measure. The factors were treatment—W, WO, or C; and ability—low, medium, or high, i.e., 90-106, 107-118, or 119-145 on the KAT.

c. An analysis of covariance of nine postwriting measures using a 3 x 2 factorial design which included all 114 Ss and, necessarily, had unequal numbers per cell. The covariate was the prewriting measure. The factors were treatment—W, WO, or C; and school—A or B.

d. An analysis of covariance of nine postwriting measures using a 2 x 3 factorial design with 16 Ss per cell (N = 96). The two covariates were KAT score and the prewriting measure. The factors were sex—male or female; and treatment—W, WO, or C. This design was used to analyze the grand total of all clause structures.

The writing samples of 114 Ss were analyzed, but in analyses a and d Ss were randomly discarded to allow equal N's for all cells. These successive and different analyses gave a thorough appraisal of the effects of the treatment, ability, sex, and school.

RESULTS

Table 16 contains the means and standard deviations of the nine writing measures and presents the means for groups according to sex, ability, and treatment for prewriting and postwriting. Table 16 is based on the 72 Ss of analysis a. In the nine analyses of the prewriting samples, there were two significant effects, neither of which lay in the assignment of Ss to treatment groups. With the linear effect due to KAT score controlled by covariance, Ss below the median KAT score wrote more subordinate noun clauses than Ss above the median ($p < .01$). The mean numbers of noun clauses (Table 16) were 12.9 for the high ability Ss and 13.6 for low. The other significant effect showed that males wrote more T-units per sentence than females (1.38 compared to 1.28, $p < .05$). No other effect or interaction due to sex, ability, or treatment was significant in the analyses of the prewriting.

Adjective Clauses

The average eighth grader wrote 45 subordinate clauses in 1000 words of writing. Of these 45 structures about one-fourth were subordinate adjective clauses. There were no differences between any of the groups in the number of these adjective clauses written in the prewriting sample, but on the postwriting sample there was evidence of a difference between treatment groups. The first analysis, in which ability (KAT score) was the covariate, showed that Ss in Group W wrote significantly ($p < .05$) more subordinate adjective clauses than did Ss in Group C. The means are shown in Table 16.

However, when the prewriting score was used as a covariate, no significant treatment differences remained in the adjective clause measure. Analysis b is shown in Table 17. The d analysis, in which two covariates (KAT score and prewriting score) were used, also showed no significant treatment effects for the adjective clause measure, though Group W was

Table 16

The Observed Means of Nine Writing Measures Obtained from the 1000-Word Prewriting and Postwriting Samples of 72 Ss

Measure	Male	Female	High KAT	Low KAT	With Exercises	Without Exercises	Control	All Ss Mean	All Ss sd.
Prewriting									
1. Adj.	10.0	11.3	10.7	10.6	10.7	10.8	10.5	10.6	4.7
2. Adv.	20.4	19.8	19.7	20.5	20.0	20.0	20.3	20.1	6.7
3. Noun	13.3	13.1	12.9	13.6	12.6	12.8	14.3	13.2	5.3
4. Comp.	.97	.94	1.14	.78	1.25	1.04	.58	.96	1.11
5. W/C	7.9	7.7	7.7	7.9	7.7	8.0	7.7	7.8	.84
6. C/T	1.56	1.57	1.55	1.59	1.54	1.59	1.58	1.57	.18
7. W/T	12.3	12.1	11.9	12.5	11.8	12.6	12.2	12.2	1.8
8. T/S	1.38	1.28	1.29	1.37	1.30	1.38	1.31	1.33	.20
9. W/S	18.8	15.5	17.1	17.1	15.4	17.4	18.6	17.1	7.9
Postwriting									
1. Adj.	11.1	10.8	10.9	10.9	12.6	10.5	9.6	10.9	3.9
2. Adv.	18.1	18.4	16.0	20.4	17.9	20.1	16.7	18.2	7.2
3. Noun	13.9	14.0	14.5	13.4	13.2	14.9	13.8	14.0	5.9
4. Comp.	1.08	.92	1.03	.97	1.00	1.17	.83	1.00	1.32
5. W/C	7.9	7.9	7.9	7.9	7.9	7.9	7.8	7.9	.74
6. C/T	1.56	1.55	1.52	1.59	1.58	1.60	1.48	1.55	.17
7. W/T	12.3	12.3	11.9	12.6	12.5	12.6	11.7	12.3	1.9
8. T/S	1.48	1.26	1.28	1.46	1.35	1.37	1.38	1.37	.34
9. W/S	18.3	15.5	15.3	18.5	17.0	17.4	16.2	16.9	5.2

writing 11.8 adjective clauses per 1000 words compared to 10.0 for Group C at the end of the experimental treatment.

No other factor was significant in the analyses of adjective clauses. Differences between males and females, differences among the three ability groups, and differences between schools were not significant, nor were interactions of the effects significant. The relevant means for the various groups are shown in Tables 16, 17, and 18. The regression coefficients between each of the covariates and the dependent variable were very small and not significant.

Adverb Clauses

About 44% of the clausal structures written were subordinate adverb clauses. There were no significant differences between sexes or among ability groups in the use of adverb clauses in the prewriting sample, and again no differences in the postwriting sample. The effect of treatment also did not approach significance. Tables 16 and 19 present these means. Only the factor of school was near the significance level, with the students in School B writing more adverb clauses in the postwriting sample than the students in School A ($p < .06$), a difference which was shown in the prewriting sample also (See Table 18). No interactions approached significance in any of the analyses of this variable.

The regression of the frequency of adverb clauses in the prewriting sample was a significant source of variance in the analysis of the postwriting sample ($p < .05$). This significance indicated that the use of adverb clauses had some stability across the two writing samples. Table 19 gives the summary of analysis b of this variable.

Noun Clauses

Approximately 13 subordinate noun clauses were written in the 1000-word samples by the average S. Adjective, adverb, and noun clauses comprised 97% of the subordinate clausal structures written by eighth graders. The analysis of prewriting showed that low ability Ss wrote more subordinate noun clauses than the higher ability Ss. On the postwriting sample this was no longer true, as shown in Table 16. In Table 20 it can be seen that the effects of treatment and ability were not significant and that the regression between prewriting and postwriting was not significant. The difference between

Table 17

Subordinate Adjective Clauses in the Postwriting Using Prewriting as the Covariate

3 x 3 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	1411.82	104	--	--
Regression	6.17	1	.45	ns
Treatment	64.37	2	2.37	.098
IQ	21.11	2	.78	ns
Interaction	29.99	4	.55	ns

Means and Adjusted Contrasts

Factor	Level	Means Pre	Means Post	Contrast $(x' - \bar{x}')$
Treatment				
34	Without Ex.	10.3	11.0	+ .14
37	With Ex.	9.9	11.8	+ .88
43	Control	9.5	10.0	- 1.02
IQ				
38	Low	10.6	10.4	- .63
33	Medium	9.0	11.3	+ .65
43	High	9.9	11.0	- .02

Raw Regression Coefficient: +.05

Table 18

The Means for the Writing Measures for Ss in Each School

Measure	School A (63)	School B (51)
Prewriting		
Adj.	9.8	10.1
Adv.	18.0	21.7
Noun	12.6	14.4
Comp.	.95	.94
W/C	8.1	7.5
C/T	1.53	1.61
W/T	12.3	12.1
T/S	1.30	1.32
W/S	15.9	16.0
Postwriting		
Adj.	11.3	10.4
Adv.	16.9	19.6
Noun	12.2	15.8
Comp.	1.08	1.10
W/C	8.1	7.4
C/T	1.54	1.56
W/T	12.5	11.7
T/S	1.35	1.37
W/S	17.0	15.9

Table 19

Subordinate Adverb Clauses in the Postwriting Using Prewriting as the Covariate

3 x 3 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	4342.10	104	--	--
Regression	229.96	1	5.51	.021
Treatment	108.71	2	1.30	ns
IQ	156.64	2	1.88	ns
Interaction	244.89	4	1.47	ns

Means and Adjusted Contrasts

Factor	Level	Means Pre	Means Post	Contrast $(x' - \bar{x}')$
Treatment				
34	Without Ex.	19.9	19.4	+ .82
37	With Ex.	19.3	18.2	+ .20
43	Control	19.6	17.0	- 1.02
IQ				
38	Low	19.8	19.7	+ 1.44
33	Medium	21.6	18.4	- .18
43	High	17.9	16.5	- 1.26

Raw Regression Coefficient: +.20

schools shown in Table 18 was significant at the .001 level. Even with the linear trend in the prewriting sample removed from consideration in the postwriting, Ss in School B wrote significantly more subordinate noun clauses than Ss in School A (15.8 compared to 12.2). A complete summary of analysis c is given in Table 21. Note that the school-by-treatment interaction is significant ($p < .05$). Individual comparisons of the postwriting means of the six groups in this interaction showed that Group WO in School B was significantly higher than all the groups in School A and also higher than Group W of School B ($p < .05$). Group C in School B was higher than Group C in School A ($p < .05$). The more conservative Newman-Keuls comparison revealed two differences; Groups WO and C in School B were higher than Group C in School A ($p < .05$).

Sex, ability, and the regression coefficient were not significant factors in the frequency of noun clauses. Treatment was significant only insofar as it interacted with the difference between schools. No interpretation of the interaction of the difference between schools is apparent, except that the higher frequency of noun clauses in School B was already noticeable in the prewriting.

Table 20

Subordinate Noun Clauses in the Postwriting Using Prewriting as the Covariate—Treatment by IQ

3 x 3 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	3324.13	104	--	--
Regression	74.95	1	2.34	ns
Treatment	55.39	2	0.87	ns
IQ	89.73	2	1.40	ns
Interaction	115.64	4	0.90	ns

Means and Adjusted Contrasts

Factor	Level	Means Pre	Means Post	Contrast $(x' - \bar{x}')$
Treatment				
34	Without Ex.	13.9	14.8	+ .90
37	With Ex.	12.2	12.9	- .51
43	Control	14.0	13.6	- .39
IQ				
38	Low	13.0	13.9	+ .19
33	Medium	15.0	15.1	+ .78
43	High	12.5	12.5	- .97

Raw Regression Coefficient: +.15

Table 21

Subordinate Noun Clauses in the Postwriting Using Prewriting as the Covariate—Treatment by School

3 x 2 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	2981.16	107	--	--
Regression	39.25	1	1.41	ns
Treatment	58.81	2	1.06	ns
School	347.29	1	12.46	.001
Interaction	205.94	2	3.70	.028

Means and Adjusted Contrasts

Factor	Level	Means Pre	Means Post	Contrast $(x' - \bar{x}')$
Treatment				
34	Without Ex. (WO)	13.9	14.8	+ 1.51
37	With Ex. (W)	12.2	12.9	- .82
43	Control (C)	14.0	13.6	- .69
School				
63	A	12.6	12.2	- 1.72
51	B	14.4	15.8	+ 1.72
Interaction				
21	WO - A	13.2	13.1	- .73
23	W - A	11.7	13.0	- .68
19	C - A	13.0	10.1	- 3.75
13	WO - B	15.1	17.8	+ 3.75
14	W - B	13.1	12.9	- .96
24	C - B	14.8	16.4	+ 2.37

Raw Regression Coefficient: +.10

Clauses of Comparison

Clauses of comparison were used very infrequently, approximately once per 1000-word sample of eighth-grade writing. No main effects or interactions were significant. The means are shown in Tables 16, 18, and analysis b is shown in Table 22.

Other Tabulated Structures

The frequencies of seven other structures were too small to analyze rigorously. The deferred subject appeared 10 times in the 114,000 words which constituted the prewriting sample; subjunctive word order, 0 times; the cleft sentence, 23; clauses complementing an adjective 34; clauses complementing a Vs, 23; "the more the merrier" construction, 4; and the special which clause, 17. In the postwriting sample these structures appeared 3, 1, 14, 36, 16, 3, and 24 times, respectively.

Clause Length

The 114 eighth graders from whom the writing samples were obtained wrote a mean of 7.8 words per clause. The clause length of male Ss was not significantly different from female Ss, nor did the ability groups differ in clause length (See Tables 16 and 23). The treatment groups did not write longer clauses than were written by the control group. The one significant factor that appeared was a difference between schools. School A students wrote longer clauses than School B students (Table 24, $p < .001$). The difference in clause length was not brought about by the experimental treatments but existed in the prewriting samples as well (Table 18). Drawing upon the significant differences between schools shown in the frequency of adverb and noun clauses and in clause length, it appears that students of School A were writing longer clauses while the trend in School B was towards a higher quantity of shorter adverb and noun clauses.

Table 22

Clauses of Comparison in the Postwriting Using Prewriting as the Covariate

3 x 3 Analysis of Covariance				
Source	Sum of Squares	df	F	p
Within Cells	157.26	104	--	--
Regression	0.24	1	0.16	ns
Treatment	1.73	2	0.57	ns
IQ	0.97	2	0.32	ns
Interaction	5.18	4	0.86	ns

Means and Adjusted Contrasts

Factor	Level	Means Pre	Means Post	Contrast $(x' - \bar{x}')$
Treatment				
34	Without Ex.	1.0	1.2	+ .20
37	With Ex.	1.2	1.1	- .03
43	Control	0.5	0.9	- .17
IQ				
38	Low	0.9	0.9	- .15
33	Medium	0.7	1.1	+ .10
43	High	1.0	1.1	+ .05

Raw Regression Coefficient: -.04

Table 23

Clause Length in the Postwriting Using Prewriting as the Covariate—Treatment by IQ

3 x 3 Analysis of Covariance				
Source	Sum of Squares	df	F	p
Within Cells	49.16	104	--	--
Regression	11.77	1	24.90	.001
Treatment	.05	2	0.06	ns
IQ	1.70	2	1.80	ns
Interaction	.74	4	0.39	ns

Means and Adjusted Contrasts

Factor	Level	Means Pre	Means Post	Contrast $(x' - \bar{x}')$
Treatment				
34	Without Ex.	7.9	7.8	- .023
37	With Ex.	7.8	7.9	+ .029
43	Control	7.8	7.8	- .006
IQ				
38	Low	7.9	7.8	- .024
33	Medium	7.6	7.6	- .134
43	High	7.9	8.0	+ .158

Raw Regression Coefficient: +.36

The regression between prewriting and postwriting was highly significant, indicating that clause length was a consistent measure of writing behavior. Clause length and the other four synopsis scores each had a regression coefficient significant beyond the .001 level.

Clauses per T-unit

This writing measure showed a significant treatment effect. As shown in Tables 25 and 26, the two experimental groups increased the average number of clauses per T-unit while the control group decreased. The difference between Groups WO and C was shown by Newman-Keuls analysis to be significant ($p < .01$) in analyses b and c, which are shown in Tables 25 and 26, respectively. When both prescore and KAT score were used as covariates, the effect of treatment was significant beyond the .01 level. Group WO wrote more clauses per T-unit than Group C. Sex and ability, and interactions of these factors, were not significant in any of the analyses of clauses per T-unit.

The clarity of the treatment effect was clouded somewhat by the presence of the school-by-treatment interaction shown in Table 26. Groups W and WO in School A increased the number of clauses per T-unit, but the other four groups showed declines. Thus, the treatment seems to have affected the Ss in the two schools slightly differently; and by Newman-Keuls analysis of differences it was shown that Group C in School A was significantly lower than Groups W and WO in School A and Group WO in School B ($p < .05$).

T-unit Length

There were no significant effects due to treatment, sex, or ability with this variable. Only the regression coefficient between pre- and postwriting was significant. Analysis b is shown in Table 27. The mean number of words per T-unit on both prewriting and postwriting was 12.2. As Table 27 shows, this consistent mean actually represents an increase by the treatment groups and a decrease by the control group, although these were not statistically significant differences.

Table 28 presents analysis c, in which school and treatment were tested, and T-unit length in prewriting was the covariate. On the postwriting, Ss in School A wrote longer T-units than those in School B ($p < .05$).

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Table 24

Clause Length in the Postwriting Using Prewriting as the Covariate—Treatment by School

3 x 2 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	44.33	107	--	--
Regression	5.58	1	13.46	.001
Treatment	.01	2	0.01	ns
School	7.91	1	19.09	.001
Interaction	.22	2	0.26	ns

Means and Adjusted Contrasts

Factor	Level	Means Pre	Means Post	Contrast (x' - $\bar{x}$')
Treatment				
34	Without Ex.	7.9	7.8	- .039
37	With Ex.	7.8	7.9	- .016
43	Control	7.8	7.8	+ .055
School				
63	A	8.1	8.1	+ .287
51	B	7.5	7.4	- .287

Raw Regression Coefficient: +.25

Table 25

Clauses per T-unit in the Postwriting Using Prewriting as the Covariate—Treatment by IQ

3 x 3 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	2.65	104	--	--
Regression	.34	1	13.33	.001
Treatment	.22	2	4.26	.017
IQ	.08	2	1.60	ns
Interaction	.09	4	0.86	ns

Means and Adjusted Contrasts

Factor	Level	Pre	Post	Contrast (x' - $\bar{x}$')
Treatment				
34	Without Ex.	1.60	1.61	+ .036
37	With Ex.	1.52	1.55	+ .018
43	Control	1.57	1.50	- .054
IQ				
38	Low	1.58	1.60	+ .034
33	Medium	1.59	1.54	- .008
43	High	1.53	1.51	- .026

Raw Regression Coefficient: +.31

Table 26

Clauses per T-unit in the Postwriting Using Prewriting as the Covariate—Treatment by School

3 x 2 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	2.66	107	--	--
Regression	.34	1	13.68	.001
Treatment	.22	2	4.35	.015
School	.00	1	0.12	ns
Interaction	.15	2	3.09	.049

Means and Adjusted Contrasts

Factor	Level	Means Pre	Means Post	Contrast (x' - $\bar{x}$')
Treatment				
34	Without Ex. (WO)	1.60	1.61	+ .049
37	With Ex. (W)	1.52	1.55	+ .009
43	Control (C)	1.57	1.50	- .058
School				
63	A	1.53	1.54	- .002
51	B	1.61	1.56	+ .002
Interaction				
21	WO - A	1.58	1.61	+ .055
23	W - A	1.49	1.57	+ .048
19	C - A	1.51	1.42	- .108
13	WO - B	1.63	1.61	+ .044
14	W - B	1.58	1.52	- .030
24	C - B	1.61	1.56	- .009

Raw Regression Coefficient: +.31

T-unit length was a stable measure, as shown by the significant regression between prewriting and postwriting, but the treatment did not statistically change Ss' behavior on this variable. Males and females were approximately the same, and the ability groups did not differ significantly (Table 16).

T-units per Sentence

Ss wrote a mean of 1.31 and 1.36 T-units per sentence on prewriting and postwriting, respectively. The means of the 72 Ss in analysis a are shown in Table 16. The difference between male and female Ss was significant in analysis a of the postwriting ($p < .01$). Analysis d, in which prewriting score and KAT score were used as covariates showed the factor of sex not significant.

Table 27

T-unit Length in the Postwriting Using Prewriting as the Covariate—Treatment by IQ

3 x 3 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	287.29	104	--	--
Regression	84.49	1	30.73	.001
Treatment	12.70	2	2.30	.106
IQ	3.29	2	0.60	ns
Interaction	10.99	4	1.00	ns

Means and Adjusted Contrasts

Factor	Level	Means Pre	Means Post	Contrast $(x' - \bar{x}')$
Treatment				
34	Without Ex.	12.6	12.6	+ .17
37	With Ex.	11.9	12.2	+ .24
43	Control	12.2	11.7	- .41
IQ				
38	Low	12.5	12.5	+ .22
33	Medium	12.0	11.8	- .22
43	High	12.1	12.1	+ .00

Raw Regression Coefficient: +.47

Table 28

T-unit Length in the Postwriting Using Prewriting as the Covariate—Treatment by School

3 x 2 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	273.74	107	--	--
Regression	83.56	1	32.66	.001
Treatment	12.72	2	2.49	.088
School	13.99	1	5.47	.021
Interaction	13.89	2	2.72	.071

Means and Adjusted Contrasts

Factor	Level	Means Pre	Means Post	Contrast $(x' - \bar{x}')$
Treatment				
34	Without Ex.	12.6	12.6	+ .24
37	With Ex.	11.9	12.2	+ .12
43	Control	12.2	11.7	- .36
School				
63	A	12.3	12.5	+ .40
51	B	12.1	11.7	- .40

Raw Regression Coefficient: +.46

Tables 29 and 30 present the other analyses of T-units per sentence. Note that even after controlling for the linear effect of differences in prewriting, the low ability group tended to put more T-units into each sentence than the medium and high Ss. The interaction of treatment-by-school was highly significant, and the contrasts in Table 30 show the pattern of the interaction. Individual comparison tests of the six groups in the interaction showed that Group C in School B and Group W in School A wrote more T-units per sentence than Group C in School A and Group W in School B ($p < .05$).

The regression coefficient between T-units per sentence in prewriting and postwriting was highly significant, but KAT score, as in all the analyses in which it was used as a covariate, accounted for only a minor portion of the postwriting variance. Treatment was not significant with this variable.

Sentence Length

Ss wrote sentences containing a mean of 16.0 and 16.6 words on prewriting and postwriting, respectively. Males tended to write longer sentences than females (Table 16), and the sentences of low ability Ss were longer on

Table 29

T-units per Sentence in the Postwriting Using Prewriting as the Covariate—Treatment by IQ

3 x 3 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	7.92	104	--	--
Regression	3.72	1	48.86	.001
Treatment	.07	2	0.45	ns
IQ	.47	2	3.06	.051
Interaction	.32	4	1.05	ns

Means and Adjusted Contrasts

Factor	Level	Means Pre	Means Post	Contrast $(x' - \bar{x}')$
Treatment				
34	Without Ex.	1.34	1.36	- .044
37	With Ex.	1.30	1.37	+ .037
43	Control	1.30	1.35	+ .007
IQ				
38	Low	1.40	1.53	+ .091
33	Medium	1.28	1.32	- .024
43	High	1.26	1.24	- .067

Raw Regression Coefficient: +.99

Table 30

T-units per Sentence in the Postwriting Using Prewriting as the Covariate—Treatment by School

3 x 2 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	8.03	107	--	--
Regression	4.56	1	60.75	.001
Treatment	.07	2	0.50	ns
School	.00	1	0.02	ns
Interaction	.71	2	4.72	.011

Means and Adjusted Covariates

Factor	Level	Means Pre	Means Post	Contrast ($x' - \bar{x}'$)
Treatment				
34	Without Ex. (WO)	1.34	1.36	- .028
37	With Ex. (W)	1.30	1.37	+ .016
43	Control (C)	1.30	1.35	+ .012
School				
63	A	1.30	1.35	+ .003
51	B	1.32	1.37	- .003
School x Treatment				
21	WO - A	1.38	1.41	- .014
23	W - A	1.28	1.42	+ .109
19	C - A	1.25	1.20	- .086
13	WO - B	1.29	1.28	- .041
14	W - B	1.34	1.30	- .078
24	C - B	1.33	1.47	+ .109

Raw Regression Coefficient: +1.05

postwriting than the sentences of the high and medium groups (Tables 16 and 31). These facts may indicate a greater use of coordination by males and low ability Ss rather than use of subordination.

Treatment was not significant, but an interaction of school-by-treatment was significant

Table 31

Sentence Length in the Postwriting Using Prewriting as the Covariate—Treatment by IQ

3 x 3 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	1670.16	104	--	--
Regression	740.18	1	46.09	.001
Treatment	42.04	2	1.31	ns
IQ	124.23	2	3.87	.024
Interaction	39.90	4	0.62	ns

Means and Adjusted Contrasts

Factor	Level	Means Pre	Means Post	Contrast ($x' - \bar{x}'$)
Treatment				
34	Without Ex.	17.0	17.3	- .33
37	With Ex.	15.3	16.8	+ .98
43	Control	15.7	15.7	- .65
IQ				
38	Low	17.4	19.2	+ 1.56
33	Medium	15.4	15.4	- .78
43	High	15.1	15.1	- .78

Raw Regression Coefficient: +.78

and is shown in Table 32. Individual comparison of the six interaction groups showed that Group W in School A was higher than Groups W and WO in School B and Group C in School A ($p < .05$). The regression between prewriting and postwriting sentence length was highly significant.

Total of All Subordinate Clauses

The tabulations of all eleven kinds of clause structures were combined into a single score for each S. Using prewriting total and KAT score as covariates, the postwriting total was analyzed in a 3 x 2 design. The difference

Table 32

Sentence Length in the Postwriting Using Prewriting as the Covariate—Treatment by School

3 x 2 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	1693.23	107	--	--
Regression	830.07	1	52.45	.001
Treatment	31.15	2	0.98	ns
School	32.27	1	2.04	ns
Interaction	167.13	2	5.28	.007

Means and Adjusted Covariates

Factor	Level	Means Pre	Means Post	Contrast $(x' - \bar{x}')$
Treatment				
34	Without Ex. (WO)	17.0	17.3	- .025
37	With Ex. (W)	15.3	16.8	+ .465
43	Control (C)	15.7	15.7	- .440
School				
63	A	15.9	17.0	+ .668
51	B	16.0	15.9	- .668
Interaction				
21	WO - A	17.5	18.5	+1.058
23	W - A	15.5	18.2	+2.357
19	C - A	14.7	13.9	-1.411
13	WO - B	16.1	15.2	-1.108
14	W - B	15.4	14.4	-1.427
24	C - B	16.3	17.1	+ .531

Raw Regression Coefficient: +.76

among treatment groups was nearly statistically significant ($.05 < p < .10$). The experimental groups, and especially Group WO, increased their use of subordination above that of the control group (See Table 33). Individual comparisons between groups showed that the mean of Group WO was higher than Group C ($p < .05$).

Table 33

The Sum of the Eleven Clause Structures in the Postwriting Using Prewriting and IQ as the Covariates

3 x 2 Analysis of Covariance

Source	Sum of Squares	df	F	p
Within Cells	7196.68	88	--	--
Regression	724.13	2	4.43	.015
Treatment	431.44	2	2.64	.077
Sex	22.08	1	.27	ns
Interaction	330.30	2	2.02	ns

Means and Adjusted Contrasts

Factor	Level	Means Pre	Means Post	Contrast $(x' - \bar{x}')$
Treatment				
34	Without Ex.	46.5	48.1	+ 2.64
37	With Ex.	43.7	44.5	- 0.08
43	Control	44.7	42.6	- 2.56
Sex				
63	Male	43.5	45.5	+ 0.49
51	Female	46.4	44.6	- 0.49

Raw Regression Coefficients:
Prewriting, + .19; IQ, - .13

V

DISCUSSION AND SUMMARY

SUMMARY

Themes were collected from eighth-grade students until each student had produced a 1000-word sample of writing. Students were then placed in an experimental situation which lasted for five weeks. During these five weeks, students were Ss in either an experimental or control condition. The experimental condition was a series of 22 programed lessons in structural and transformational grammar. One experimental group (WO) received only these 22 lessons, a second experimental group (W) received the lessons plus writing exercises which followed each lesson. The control group (C) did not study grammar during the five-week period but had units on literature and speaking. A pretest was given to all Ss on the first day of the experiment. The experimental groups studied 10 daily lessons on structural grammar which consisted of basic sentence patterns and the structures within each pattern. The pretest was given as a posttest following these 10 lessons. A second pretest and a sentence-combining task preceded the remaining 12 lessons, which were a study of transform processes. This second pretest was used as a second posttest on the last day of the experiment. Writing samples amounting to 1000 words were again collected from all students following the experiment.

The pretests and posttests of 207 Ss were analyzed by analysis of covariance for significant effects due to treatment, ability, sex, and school. The pre- and postwriting samples of 114 Ss were analyzed by analysis of covariance for these same effects. The covariate was either the IQ score on the Kuhlmann-Anderson Test or the prescore. For some analyses of postscores, both IQ and prescore were used as covariates.

The initial analysis, which tested the effects of sex and treatment, and used KAT score as a covariate, revealed the following effects in the pretests and posttests:

1. There were no differences among Groups W, WO, and C on Pretest I, Pretest II, or on the sentence-combining tasks of Pretest III.
2. Females scored higher than males on Pretest I and Pretest II ($p < .01$) and on Pretest II ($p < .05$).
3. There were no significant interactions of sex-by-treatment on the pretests.
4. The regression coefficients between KAT score and pretest scores were not significant.
5. There were significant differences between treatment groups on Posttest I and Posttest II. Groups W and WO scored significantly higher than Group C ($p < .01$) on both posttests. No differences, though, existed between W and WO. On the sentence-combining tasks (Posttest III) no significant differences among Groups W, WO, and C appeared.
6. Females scored higher than males on Posttests I and II ($p < .01$), but no significant sex differences were present on Posttest III.
7. There were no significant sex-by-treatment interactions on any of the posttests.
8. The regression coefficients between KAT scores and posttest scores were not significant.

A more thorough analysis of the posttests, an analysis which used all 207 Ss, pretest score as a covariate, and tested the factors of ability sex, school, and experimental vs. control, showed the following:

1. The experimental Ss scored higher than the control Ss on Posttest I and II ($p < .001$) and on Posttest III ($p < .05$).
2. Females scored higher than males on Posttest II ($p < .01$), but no sex differences appeared on Posttests I and III.
3. Ss of high ability, as measured by KAT, scored higher than Ss of medium ability who in turn scored higher than Ss of low ability on

Posttests I and II ($p < .01$). The trend was similar but not significant on Posttest III.

4. Ss of School A scored higher than those of School B on Posttest I ($p < .01$) and Posttest III ($p < .001$). No differences were present on Posttest II.

5. A treatment-by-school interaction was significant on Posttest I ($p < .01$). It appeared that the experimental Ss of School A gained more from the treatment than the experimental Ss of School B. A treatment-by-IQ interaction was significant on Posttest III ($p < .05$) and also an ability-by-school interaction ($p < .05$).

6. The regression coefficients between pretest and posttest score were highly significant ($p < .001$) for all three sets of tests.

The posttests were again analyzed using both KAT score and pretest score as covariates. The factors tested were school, sex, and treatment (W vs. WO vs. C). The sum of Posttests I and II was also analyzed. This design using 144 Ss revealed the following:

1. Groups W and WO scored higher than Group C on Posttests I and II and the sum of I and II ($p < .01$). No significant treatment differences were found on Posttest III.

2. Females scored higher than males on Posttests I and II and the sum of I and II ($p < .05$). No significant sex differences were found on Posttest III.

3. Ss of School A scored higher than Ss of School B on Posttests I and II ($p < .01$) and on the sum of Posttests I and II ($p < .001$). No significant school differences were found on Posttest III.

4. There was a treatment-by-school interaction on Posttest I and the sum of Posttests I and II ($p < .01$). Experimental Ss in School A scored higher than the experimental Ss of School B. There was a school-by-sex interaction on Posttest III ($p < .05$).

5. The regression coefficients between the covariates and the posttest scores were significant for each posttest and the sum of Posttests I and II ($p < .001$).

The writing scores from the 1000-word prewriting samples and the 1000-word postwriting samples were analyzed for the factors sex, ability, and treatment. Nine writing measures were anlayzed with a 2 x 2 x 3 design using KAT score as a covariate. The results showed:

1. No significant differences between treatment groups on any of the prewriting measures, which included adjective, adverb, and noun clauses and clauses of comparison, and measures of clause length, sentence length, T-unit length, clauses per T-unit, and T-units per sentence. On postwriting, Group W wrote more adjective clauses than Group C ($p < .05$), and Groups W and WO wrote more clauses per T-unit than Group C ($p < .05$).

2. Males wrote more T-units per sentence than females on the prewriting ($p < .05$) and on postwriting ($p < .01$). Males wrote longer sentences than females on postwriting ($p < .05$). No other measures showed significant differences between sexes on pre- or postwriting.

3. Ss below the median in ability wrote more noun clauses than Ss above the median on the prewriting sample ($p < .01$). This difference disappeared on postwriting and no other differences between ability levels were present.

4. There was a significant three-way interaction in the number of noun clauses written in the prewriting sample ($p < .05$) and in the number of adverb clauses written in the postwriting sample ($p < .05$).

5. The regression coefficients between KAT score and the various writing measures were not significant.

The postwriting measures were analyzed again, this time using prewriting scores as the covariate and 114 Ss. The factors of ability and treatment were considered. The results showed:

1. The measure of clauses per T-unit was the only measure revealing a significant difference between experimental and control groups. W and WO wrote more clauses per T-unit than Group C ($p < .05$).

2. Low ability Ss wrote longer sentences than medium and high ability Ss ($p < .05$). No other significant differences existed between ability groups.

3. No significant interactions were present on any of the postwriting measures.

4. The regression coefficients between pre- and postwriting measures were significant for six of the measures: adverb clauses ($p < .05$), clause length, clauses per T-unit, T-unit length, T-units per sentence and sentence length ($p < .001$).

Another analysis of covariance tested the factors of school and treatment. Using 114 Ss, and with prewriting score as the covariate, the analysis revealed:

1. The number of clauses per T-unit was the only measure revealing a significant difference between experimental and control groups. W and WO wrote more clauses per T-unit than Group C ($p < .05$).

2. The students in School A wrote fewer adverb clauses ($p < .06$), fewer noun clauses, longer clauses ($p < .001$), and longer T-units ($p < .05$) than students in School B.

3. There was a significant treatment-by-school interaction in four of the postwriting measures: noun clauses, clauses per T-unit ($p < .05$), T-units per sentence, and sentence length ($p < .01$).

4. The regression coefficients between pre- and postwriting measures were significant for six of the measures: adverb clauses ($p < .05$), clause length, clauses per T-unit, T-unit length, T-units per sentence, and sentence length ($p < .001$).

A fourth analysis of postwriting measures used both KAT and prewriting as covariates. Treatment and sex were the factors tested using 96 Ss. The sum of all clauses was analyzed using this design. The results were:

1. On the measure, clauses per T-unit, Group WO was higher than Group C ($p < .01$). Group WO was higher than Group C when the total of all clause structures was considered ($p < .05$). No other significant differences between treatment groups were present.

2. No significant sex differences appeared in any of the measures.

3. No significant interactions were shown.

4. The regression coefficients between the covariates and postwriting measures were significant in the analysis of adverb clauses and clauses per T-unit ($p < .01$), clause length, T-unit length, sentence length, and T-units per sentence ($p < .001$), and the sum of all clause structures ($p < .05$).

In addition to tests and writing samples, the experimental Ss responded to a questionnaire which asked for opinions on aspects of the experimental treatment. This questionnaire revealed the following results:

1. The length, the pace, and the vocabulary were judged appropriate by the majority of students.

2. Most students peeked at answers a small number of times.

3. Students found the summary sheets helpful.

4. Almost all students thought that the programed lessons were more interesting and more helpful than the traditional approach.

5. The items rated most helpful were the clues for recognizing nouns, verbs, adjectives, and adverbs, and the test-sentences. Basic sentences and transform processes were not rated as highly.

6. Basic sentence patterns were judged easier than the transform processes. Particular transform processes were all judged about equally difficult.

7. Students believed that programed lessons with teacher's help would be the preferred learning situation.

Measures of the error rates and the time requirements of each lesson showed:

1. All lessons except No. 14 had an error rate below 5%.

2. The error rate for Ss below the median KAT score was approximately twice the error rate of Ss above the median.

3. The average time spent on a lesson was 19.8 minutes. Ss below the median on KAT averaged 20.6 minutes, Ss above the median, 19.1 minutes.

CONCLUSIONS

Ss in Groups W and WO learned concepts of structural and transformational grammar. They were able to use the vocabulary of these grammars, apply the concepts in test situations, and, to some extent, use transform processes to rewrite a series of basic sentences. There was some evidence that the learning of these concepts transferred to Ss' independent writing. In the postwriting, more clauses per T-unit were written by the experimental Ss than by the control Ss. This difference indicated that the use of subordination was influenced by the experimental treatment. When the total number of eleven kinds of subordinate clauses was considered, the average S in Groups W, WO, and C wrote 44.5, 48.1, and 42.6 clauses, respectively, in 1000 words of writing. Though no differences were significant in the other measures of the postwriting samples, all differences pointed in the direction of greater writing maturity for the experimental groups. It must be kept in mind that the present experimental treatment required a rather short daily study period on each of 22 days. The average student spent 7 to 8 hours working with the programed lessons. This was a comparatively brief and short-term exposure to a set of new concepts. A longer time period with more extensive and intensive training and practice in applying the concepts may have produced a more apparent increase in writing maturity. The fact that the concepts had been grasped, however, was shown in the improvement of the experimental groups from pretest to posttest. Moreover, the students felt that the programs were a pleasant break from the usual teacher lecture, and that many of the concepts would be useful to them.

The differences between the two experimental groups, W and WO, were minimal. On some measures, adjective clauses and Posttests I and II, the group that used the exercises and received some teacher feedback tended to score higher, but on other measures, adverb clauses, noun clauses, clauses per T-unit, total clauses, sentence length, and Posttest III, the group that

used only the programed lessons was higher. However, none of these differences was statistically significant. Thus, the use of exercises as supplements to the programed lessons may have some slight justification from the results, but the major portion of teaching was already achieved by the programed lessons.

In absolute terms the changes caused by the experimental treatment were not as great as anticipated. On Posttest I and II, the experimental groups gained approximately eight and four points, respectively. For the combined tests the 12-point improvement represented one-eighth of the questions, or alternatively, it was equivalent to an increase of 27% over pretest score. On the two sentence-combining problems, the experimental groups achieved an increase in clause length averaging 2.8 words from pretest to posttest. This increase represented about one-eighth of the embedding possible, or an increase of 18% over pretest score. Writing measures showed even less change in most instances, and apparently the treatments were not highly successful in achieving positive transfer on writing behavior. The use of subordinate clauses increased 2.7%, clause length remained the same at 7.9 words, clauses per T-unit increased 1.3%, T-unit length remained approximately the same at 12.4 words, T-units per sentence increased 3.4% rather than declining as intended, and sentence length increased 5.6%.

There were some slight differences between male and female students. These differences tended to show that the males were slightly less mature writers than the females and that their achievement was less on the tests. Males averaged 6.5 points less on Posttests I and II than females, differences that were evident on the pretests. The males did less embedding on the sentence-combining problems (approximately two words). On the writing measures, males tended to show immaturity by writing slightly longer sentences and more T-units per sentence. The use of subordination by both sexes was not significantly different. The experimental treatment affected males and females similarly, and no special adjustments seem necessary in the programed lessons.

One surprising result was the lack of significant differences between different ability levels on the writing measures. The only significant differences showed low ability Ss writing longer sentences and more T-units per sentence than the medium and high ability Ss. This implies that the low Ss were slightly less mature writers. However, the low Ss wrote longer T-units, more clauses per T-unit, and more adverb clauses (in all cases not significantly more) than medium and high ability Ss. Medium Ss were highest in the number of adjective and noun clauses, while the high Ss wrote the longest clauses. Aside from these small differences on the writing measures, the pre- and posttests showed the expected differences due to ability. The total scores for low, medium, and high ability Ss on the pretests were 47.0, 60.8, and 76.4, respectively. On the posttests the totals were 55.0, 68.9, and 85.2, respectively.

The school variable was difficult to interpret, or rather, its presence as a significant variable was difficult to justify. Since programed lessons minimize the role of the teacher, no significant differences between Teacher A in School A and Teacher B in School B were expected. However, School A Ss scored three points higher on the total of the posttests than did School B Ss. Interactions showed that experimental Ss in School A gained especially from the lessons. Other results from writing measures showed that Ss in School A seemed to be more mature writers at the end of the experimental treatment than the Ss in School B. School A Ss were writing longer clauses, T-units, and sentences while School B Ss were using more adverb and noun clauses. Interactions again seemed to imply that Ss in School A gained from the experimental treatment to a greater extent than those in School B. We have no way of knowing what caused this difference between the two school populations. It may have been simply the result of one teacher helping the students adjust to the programed learning situation, and the other teacher achieving this adjustment to a lesser degree.

One purpose of the present study was to show that eighth graders in a normal school setting would learn concepts of structural and transformational grammar when these concepts were presented in a programed format. After five weeks, representing approximately 8 hours of actual study, Ss who worked with such programed lessons scored significantly higher on tests than their classmates in a control condition. In the writing of themes there was a significant difference favoring the experimental Ss in the use of subordination. Other measures of writing maturity favored the experimental groups also, but were not significant. Thus, the second purpose, transfer of knowledge to the writing situation, was not fully achieved. The transfer and use of grammatical knowledge in the writing of themes has historically been difficult to demonstrate. It may in fact require a much longer period of time than five weeks. Achieving transfer may require extensive drill in combining previously prepared kernel sentences. Such pseudoproduction of complex

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transformed sentences has been shown to increase the complexity of the student's independent writing, though the overall quality of themes is not enhanced (Mellon, 1967). Perhaps a combination of the methods used in the present study and in the sentence-combining tasks of the Mellon study would, if applied for a period of at least one school year, produce substantial increases in the quality and maturity of student writing.

APPENDIX A

GENERAL OUTLINE OF CONCEPTS IN PROGRAM

BASIC SENTENCE PATTERNS AND FORM CLASSES

Lesson 1: A Look at Basic Sentences
- — basic sentence
- — subject and predicate groups
- — NP
- — noun test-sentence

Lesson 2: Basic Sentence Patterns 1 and 2
- — forms of be
- — completer
- — adj test-sentence

Lesson 3: Basic Sentence Pattern 3 and Review
- — adv-place, adv-time
- — prep phrase

Lesson 4: Basic Sentence Pattern 4
- — VP
- — verb (identify by position)
- — adv-manner
- — optional adv

Lesson 5: More About Nouns
- — noun markers
- — plural form
- — pronouns

Lesson 6: Recognizing Verbs
- — verb markers
- — verb forms and endings:
  - simple (to), present (-s),
  - $past_1$ (-d, -ed),
  - $past_2$ (-n, -en)
    with have, has, had
  - -ing form
    with form of be

Lesson 7: Recognizing Adverbs
- — position
- — adv markers
- — adv endings: -ly, -wise, -ward(s)

Lesson 8: Adjectives with Patterns 5 and 6
- — Vs - verb like seem
- — Vb - verb like become
- — adj: markers
  - position
  - endings - -y, -able, -ish, -en, -ful, -ous

Lesson 9: Basic Sentence Pattern 7 and 8
- — two-word verbs
- — pronouns as completers

Lesson 10: Basic Sentence Pattern 9 and General Review
- — test pattern to distinguish Pattern 8 and 9

TRANSFORMS–EXPANDING THE NP

Lesson 11: Introduction to Transform Sentences and Related Clauses
- — NP expansion
- — transform sentence vs. basic sentence
- — transform (as a method)
- — related clause
- — relating pronoun

Lesson 12: T-rel (transform process for related clauses)
- — T-rel process: Step 1 and Step 2
- — insert and base

Lesson 13: T-rel Again
- — relating adverb
- — use of whom

Lesson 14: T-rel after T-pos (transform process for possessive construction)
- — possessive NP
- — use of whose

Lesson 15: T-pass (transform process for passive construction)

Lesson 16: T-ph (transform process for phrase constructions)
- — -ing phrase
- — $past_2$ phrase
- — prep phrase

Lesson 17: T-BN (transform process for placing single words before the noun)

Lesson 18: T-NP and Double Nouns (transform process for placing one NP after another)
- — double nouns

TRANSFORMS–REPLACING THE NP

Lesson 19: T-NC (transform process for constructing noun clauses)
- — noun clause

Lesson 20: T-V_{to} (transform process for constructing V_{to} nominals)
- — nominal
- — V_{to}
- — V_{to} phrase

Lesson 21: T-V_{ing} (transform process for constructing -ing nominals)
- — V_{ing}
- — V_{ing} phrase

Lesson 22: Adj and Adv Nominals and Review of Nominals

APPENDIX B
EXAMPLE WORKSHEET

A. Use each V listed below in a Pattern 4 sentence (NP + V) by supplying an NP subject group. You may use an optional adv after the V if you wish.

1. _____crackled_____.

B. For each of the sentences below, write in a V of your own. If there are verb markers given, be careful to use the appropriate verb form.

1. Aunt Hilda _____ in the garden yesterday.

C. Using T-rel, combine the insert and the base for each pair of sentences.

1. Base: < The snow paralyzed the city.>
   Insert: < The snow fell last night.>

D. In almost anything you write, you will probably have a chance to use one NP to expand another—in a report for science, a paragraph for social studies, an essay for English. Could a term be clarified? or a definition made more precise and informative? Write three sentences, making each one contain an NP expanded by another.

E. In addition to using related clauses, you may often use various kinds of phrases to avoid sounding uninteresting and monotonous. Whether you expand an NP with a related clause or with a phrase depends on what you want to say and what you think is a more pleasing way to say it. Each sentence below contains a related clause. The same information might be told in a different, but equally acceptable, way by reducing the related clause to a phrase. Applying T-ph, rewrite each transform sentence.

1. < The tomatoes that were picked yesterday are ripe.>

F. Suppose that an imaginary story you are writing takes place in Mexico. In one part of the story you want to describe a small event, and you want to use the information given below. In a more interesting way, tell this same information. You may use any transform to place parts of one sentence in another sentence.

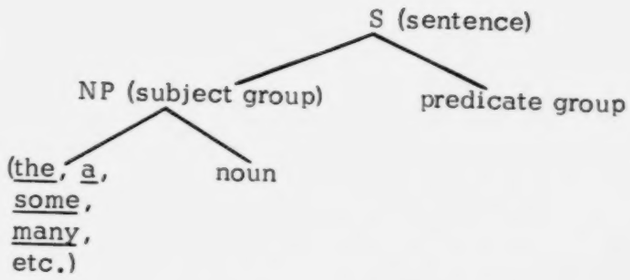
< The donkey trudged down the path.>
< The donkey was gray.>
< The donkey was pulling a cart.>
< The cart was wooden.>
< The cart was dusty.>
< Several children ran at his side.>
< The children were laughing.>
< The children had straight hair and sparkling, black eyes.>

APPENDIX C
SUMMARY SHEET FOR LESSON I

For the first ten lessons, we will be working with nine kinds of very simple sentences called BASIC sentences.

All English sentences have two main parts, which are called the SUBJECT GROUP and PREDICATE GROUP. Many kinds of structures can act as the subject group of a sentence, but in basic sentences the subject group is always a NOUN PHRASE, or NP.

If an NP consists of more than one word, the NP, too, can be divided into two main structures. One of the structures may be described as a NOUN. The following sentence "tree" may help you see more clearly how the structures of a sentence are related to each other. As we go along we will add other "branches" to the "tree."



A noun is a word like carnivals, butterfly, happiness, and Joe. Later you will learn several other clues for recognizing nouns. For now a fairly reliable way to determine whether or not you can describe a certain word as a noun is to use it in the noun test-sentence:

< (The) _____ is/are here.>

APPENDIX D
STUDENT QUESTIONNAIRE

In answering these questions, please give the answer which truly says how you feel.

1. How do you feel about the length of the lessons?

   _____Too long
   _____Just right
   _____Too short

2. How interesting were the lessons to you?

   _____Very interesting
   _____Somewhat interesting
   _____Not interesting

3. How do you feel about doing one lesson per day?

   _____Too fast
   _____Comfortable pace
   _____Too slow

4. To what extent do you feel that this new kind of grammar is more helpful to you than what you have been learning?

   _____Very much
   _____A little
   _____Not at all

5. How frequently did you peek at the correct answer to a frame before writing down your own answer?

   _____Not at all
   _____One to three times a lesson
   _____More than three times

6. How do you feel about the vocabulary used in the lessons?

   _____Very difficult
   _____Somewhat difficult
   _____Not difficult

7. How do you feel about the helpfulness of the summary sheet after every lesson?

   _____Very helpful
   _____Somewhat helpful
   _____Not helpful

8. How often did you refer back to the summary sheet of a previous lesson?

   _____Not at all
   _____One to five times
   _____More than five times

9. To what extent is this new grammar more interesting than what you have been learning?

   _____Very much
   _____A little
   _____Not at all

10. To what degree do you feel that what you learned about the following things will be helpful to you in the future?

	Very helpful	Somewhat helpful	Not helpful
a. basic sentences	_____	_____	_____
b. test-sentences	_____	_____	_____
c. clues for recognizing a noun, verb, adj, adv	_____	_____	_____
d. transform processes for combining shorter sentences to expand an NP (T-rel, T-BN, T-ph, T-NP, etc.)	_____	_____	_____

	Very helpful	Somewhat helpful	Not helpful
e. transform processes for making nominals (T-NC, $T-V_{to}$, $T-V_{ing}$)	_____	_____	_____

11. Did you do a worksheet after each lesson?

_____Yes — GO TO QUESTION #12
_____No — GO TO QUESTION #18

12. To what extent did the worksheets help you to see how you could use what you had learned in the lessons?

_____Substantially
_____To some extent
_____Very little

13. For the lessons on transforms, what kind of exercise did you like best?

_____Combining a series of 3 or more sentences
_____Breaking down a transform sentence into basic sentences
_____Free writing on anything I chose

14. How often were you NOT able to finish a lesson and a worksheet within one class period?

_____One to three times
_____Three to five times
_____I always finished

15. What do you think about the directions given to you on the worksheets?

_____Usually clear
_____Sometimes not clear
_____Usually not clear

16. About how many times did your teacher have to help explain the directions for the worksheets?

_____One to three times
_____Three to five times
_____More than five times

17. To what extent did the worksheets help you understand the lesson better?

_____Substantially
_____To some extent
_____Very little

18. Decide which of the items listed below was the most difficult for you to learn, and then write "1" next to it. Rank the others in decreasing difficulty. The least difficult will then be "8."

_____T-rel (related clauses)
_____basic sentence patterns
_____subject group and predicate group
_____T-pass (passive construction)
_____T-NC (noun clauses)
_____$T-V_{to}$ (V_{to} nominals)
_____T-BN (single words before a noun)

_____
(Write in your own choice.)

19. How would you like to have new material presented to you? Rank the following alternatives, assigning "1" to the method you think would help you most.

_____programed lessons alone
_____programed lessons with teacher's help
_____standard textbook form
_____teacher lecturing

20. What advice can you give which would help in revising the lessons, worksheets, and summary sheets?

What other comments do you have?

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